

SOCIAL-COMMUNICATION AND SELF-REGULATION DEVELOPMENT IN CHILDREN WITH AUTISM SPECTRUM DISORDER

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ABSTRACT

Sallie Wallace Nowell: Social-Communication and Self-Regulation Development in Children with Autism Spectrum Disorder
(Under the direction of Linda R. Watson)

This dissertation is comprised of two manuscripts presenting original research focused on elucidating the relationship between social-communication and self-regulation in the development of young children diagnosed with Autism Spectrum Disorder (ASD). The first manuscript explores the association between early social-communication (i.e., joint attention) and sensory regulatory components of self-regulation (i.e., hyporesponsiveness and sensory seeking behaviors) at 13 and 22 months and examines these early behavioral constructs as predictors of communication competence in preschool using a community sample of children at-risk for ASD. Results indicated that social-communication and self-regulation are related constructs in early childhood. Joint attention at 13 months was a key predictor of both joint attention and sensory regulatory features at 22 months. Sensory regulatory features at 22 months predicted receptive language, expressive language, and social-communication symptom severity in preschool. The second study examines the efficacy of an existing parent-assisted group intervention for 1st and 2nd graders with ASD targeting social-communication and self-regulation. Preliminary evidence supports the efficacy of this intervention for teaching social-communication and self-regulation knowledge to children with ASD and their parents. These manuscripts, taken together, may offer preliminary evidence for key intervention targets related to social-communication and self-regulation in young children with or at-risk for ASD.

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CHAPTER 1: INTRODUCTION TO SELF-REGULATION AND SOCIAL-COMMUNICATION IN CHILDREN WITH AUTISM SPECTRUM DISORDER

This dissertation is comprised of two empirical research studies aimed at addressing a critical problem: Nearly half (44%) of children with autism spectrum disorder (ASD) have average to above average cognitive ability (Christensen, 2016), often referred to as “high functioning,” yet their adult outcomes are poor compared to typically developing peers (Dijkhuis, Ziermans, Van Rijn, Staal, & Swaab, 2016; Howlin, Moss, Savage, & Rutter, 2013) and peers with ASD who have below average cognitive ability (Mordre et al., 2012). Social-communication and self-regulation are skill areas in which high functioning individuals with ASD struggle and contribute to the poor adult outcomes in this population. Considering that behavioral risk markers of a later diagnosis of ASD can be identified as early as 12 months of age by parent report (First Year Inventory; Reznick, Baranek, Reavis, Watson, & Crais, 2007) and via observational measures (e.g., Autism Diagnostic Observation Schedule, Toddler Module; Luyster et al., 2009), it may be feasible to address social-communication and self-regulation deficits early in life and ameliorate the cascading effects of these deficits on adult outcomes. Thus far, several studies have investigated the domain of social-communication in children with ASD, yet few studies have addressed the associations between social-communication and self-regulation in the development of children with ASD, which may be critical to designing interventions and ultimately optimizing adult outcomes. The first study in this dissertation explores the relationship between early social-communication and self-regulation skills and their

impact on preschool language and social-communication skills. The second study examines the efficacy of an existing community-based, parent-assisted, intervention for children with high functioning autism that targets both social-communication and self-regulation skills.

Social-communication is a core symptom domain in ASD (American Psychiatric Association, 2013). This large developmental construct encompasses the, often subtle, knowledge, skills, and behaviors necessary to fulfill the needs of one's social interactions (ASHA, 2017a; Hwa-Froelich, 2015). It involves understanding and use of verbal and non-verbal communication skills as well as flexible implementation of these skills during dynamic reciprocal interactions with others (Goldstein and Morgan, 2002; Muller, 2000; Muma, 1991; Gallagher, 1991; Ninio & Snow, 1996). Early social-communication challenges in ASD have cascading effects on social outcomes. For instance, early joint attention deficits are correlated with reduced duration, frequency and quality of parent-child interactions (Laurent & Gorman, 2017; Morales et al., 2005; Siller et al., 2013). As children get older, social-communication deficits have been shown to negatively impact academic performance (Welsh, Parke, Widaman, & O'Neil, 2001), be correlated with anxiety and depression (Barnhill, 2001), and affect social inclusion outcomes in adulthood including friendships and employment (Howlin et al., 2013). Moreover, recent studies have shown that high functioning young adults with ASD are more likely to self-medicate with alcohol or drugs to cope with their social-communication deficits, putting them at greater risk of substance use disorders than peers without a diagnosis of ASD (Butwicka et al., 2017; Lalanne et al., 2015).

Self-regulation may be defined as any effort to control, alter, or modify one's own behavior and emotions in accordance with the demands of a situation. Self-regulation is a continuum that includes: 1) control over body function, 2) control over emotional expression, and 3) control over

attention. Skills on the self-regulation continuum mature over the course of development.

Arousal and state organization are typically established in the first 3 months of life while impulse control does not begin to develop until a child's second year of life (Bronson, 2000). Though self-regulation deficits are not a core diagnostic symptom domain of ASD (APA, 2013), these skills are known to have a delayed developmental trajectory for individuals with ASD and difficulties with maladaptive emotional responses such as self-injury, aggression, irritability, and temper tantrums have long been reported as characteristic of the disorder (Lecavalier, 2006; Quek et al., 2012). Recently, Samson and colleagues (2014) found that ASD symptom severity was strongly correlated with emotional regulation deficits in children and adolescents with ASD and that individuals with ASD had greater emotional regulation deficits than a non-ASD control group. Furthermore, research has demonstrated that children and adolescents with ASD use less adaptive self-regulatory coping strategies (e.g., crying, avoiding) when exposed to mildly frustrating situations compared to controls without ASD (Jahromi et al., 2012; Konstantareas & Stewart, 2006). When compared to a typically developing age-matched control group, Zantinge and colleagues (2017) found that children with ASD demonstrated similar physiological responses to frustrating stimuli; however, their behavioral coping strategies were less constructive than those used by typically developing peers. Furthermore, language ability in the children with ASD was associated with their employment of more constructive vs. less constructive coping strategies in response to frustrating stimuli, but executive functioning was not, indicating that language deficits in ASD may play a greater role in self-regulation skill development than executive functioning deficits (Zantinge et al., 2017).

In the context of early learning, self-regulation development has a clear relationship with other developmental processes. Young children learn through play, which involves social

interaction (e.g., regulating attention to a caregiver, regulating emotional state to keep the interaction going rather than fussing) and sensory-motor skills (e.g., regulating body impulses in order to reach for a toy only when it is their turn). By school age, these early self-regulation skills are refined such that children consciously use them to follow classroom expectations (e.g., paying attention while the teacher is talking, staying quiet in the hallway) and independently engage in social interactions with peers (e.g., regulating eye contact and turn taking, following the rules of a game, attending to non-verbal messages, avoiding emotional outbursts in front of friends), and even reflect on the behavior of others by noticing if other children do not use socially expected behaviors (Bronson, 2000). If social-communication and self-regulation skills are closely linked and critical to success in academic and interpersonal contexts, it is no surprise that children with ASD, for whom social-communication and self-regulation are deficit areas, struggle with these skills and that early deficits in these developmental areas contribute to poorer adult outcomes.

Sensory regulatory features may be conceptualized as components of early self-regulation behaviors including orienting attention to sensory stimuli and engaging in or repeating comforting sensations during times of dysregulation. Unusual sensory interests and responses to sensory stimuli are associated with emotion regulation difficulties in individuals with ASD (Samson et al., 2014). Moreover, the DSM-5 recognizes unusual sensory regulatory features as part of an ASD diagnostic profile (APA, 2013). Hyporesponsiveness is the absence of or delayed orienting to social and nonsocial stimuli in a child's environment, while sensory seeking behaviors are soothing or compensatory behaviors that children use to modulate their arousal level, whether they are over- or under-stimulated (Ausderau et al., 2014; Watson et al., 2011). Sensory seeking behaviors may co-occur with hyporesponsiveness as children may "up regulate"

themselves by seeking other sensations (e.g., mouthing objects, hand flapping) while tuning out salient stimuli (e.g., hearing their name called, attending to a book during story time). Both hyporesponsiveness and sensory seeking are negatively associated with language and social-communication skills in children with ASD (Watson et al., 2011), and are therefore of particular relevance to the development of social-communication and self-regulation skills which are the focus of this dissertation.

This dissertation is comprised of two empirical studies designed to further elucidate the role of social-communication and self-regulation skills in the development of young children with ASD. The first study explores the relationship between an early social-communication skill (i.e., joint attention) and sensory regulatory components of self-regulation (i.e., hyporesponsiveness and sensory seeking behaviors) at 13 and 22 months and examine these early behavioral constructs as predictors of language and social-communication skills in preschool using a community sample of children who were identified as at-risk for ASD at 12 months of age. The second study examines the efficacy of an existing parent-assisted group intervention for 1st and 2nd graders with high functioning ASD targeting social-communication and self-regulation. Results of the studies, taken together, may offer preliminary evidence for the developmental sequencing of key intervention targets related to social-communication and self-regulation in young children with or at risk for ASD with average to above average cognitive abilities, and may contribute to addressing the critical problem of poor adult outcomes in this population.

CHAPTER 2: JOINT ATTENTION AND SENSORY REGULATORY FEATURES AT 13 AND 22 MONTHS AS PREDICTORS OF LANGUAGE AND PRAGMATIC OUTCOMES IN PRESCHOOL

Overview

This study used cross-lagged panel analysis models to examine the relationship between joint attention and sensory regulatory features (i.e., hyporesponsiveness and sensory seeking behaviors) at 13 and 22 months of age in a sample of children who were identified via community screening as at-risk for Autism Spectrum Disorder (ASD) at 12 months. The final cross-lagged panel model indicated that there were significant concurrent relationships between these constructs at 13 and 22 months and predictive relationships between each construct from 13 to 22 months, but joint attention at 13 months was the only variable needed in the model to predict both joint attention and sensory regulatory features at 22 months. The models were then extended to predict distal language and social-communication outcomes in the sample at preschool age. Language and social-communication outcomes were best predicted by cross-lagged panel models with sensory regulatory features at 22 months as the only predictor. In summary, results indicate that joint attention and sensory regulatory features are significantly related constructs in early childhood development that have cascading effects on language and social-communication. Outcomes in language and social-communication at preschool-age, seem to be best predicted by joint attention at 13 months and sensory regulatory features at 22 months.

Introduction

Joint attention is a term used to describe a set of behaviors such as eye gaze, pointing, and showing, which are implemented to include outside objects during a communicative exchange (Carpenter, Nagel, & Tomasello, 1998; Charman, 2003). According to the Parallel and Distributed Processing (PDP) Model, joint attention involves parallel processing of self-referenced information and processing of another person's attention and behavior, as well as integration of the information about self and others with information about a mutually referenced object or event (Mundy & Jarrold, 2011). In the development of children with Autism Spectrum Disorder (ASD), joint attention skills are considered "pivotal" because they are known to be critical precursors of later social and language skills (Charman, 2003; Poon, Watson, Baranek, & Poe, 2012). Based on a meta-analysis of nearly 4,000 children, half with ASD and half with typical development, Bottema-Beutel (2016) concluded that joint attention was more closely related to language outcomes in children with ASD than those with typical development because typically developing children acquire joint attention skills early enough that language outcomes become contingent upon development of more advanced skills, while development of language in children with ASD remains dependent upon acquisition of joint attention for an extended period of time. Mundy and Jarrold's (2011) PDP Model posits that joint attention skills contribute to the neurocognitive foundation of social cognition, symbolic thought, and self-awareness, all of which are critical for effective information sharing during social interactions. The self-referenced processing aspect of joint attention alone requires interoception (i.e., regulation of physiological information, emotion) and proprioception (i.e., regulation of body movement), both of which are formative for self-regulation and social cognition (Mundy & Jarrold, 2011). In fact, children who engage in more joint attention behaviors have been found to demonstrate greater adaptive self-regulation skills

during mildly frustrating situations (i.e., being asked to share a toy with which they are engaged), such as complying or verbally protesting rather than crying or physically aggressing (Gulsrud et al., 2010; Raver, 1996; Samson et al., 2014). A potential implication of the PDP Model is that the relationship between joint attention and sensory regulatory features in early childhood is essential in the development of language and social-communication competence in children with ASD. This study aims to explore that relationship and its influence on communication competence in a sample of children at-risk for ASD.

Sensory-regulation is theorized to be a component of self-regulation, because more difficulties with adaptive sensory responses and unusual sensory interests are associated with greater emotional self-regulation challenges in children with ASD (Samson, 2014). Maladaptive sensory responses influence social-communication because social interactions require integration of multiple sources of sensory input (Dionne-Dostie et al., 2015). Baranek (2001) proposed the *Optimal Engagement Band Model for Sensory Processing in Young Children with Autism* (Figure 2.1), which demonstrates how maladaptive sensory responses to environmental stimuli in ASD restrict the band of optimal engagement for these children and therefore reduce the frequency and variety of social experiences in which they can engage. For instance, if a child seeks to look at the glare on the surface of the swimming pool and, while doing this, does not respond at all to other children, toys, or caregivers, he will have a restricted experience of the swimming pool environment and fall behind children who are socializing, learning to swim, and building vocabulary in that environment. Having a restricted optimal engagement band and limited toleration of social experiences in early childhood as compared to typically developing peers is theorized to have long-term negative effects on social-communication.

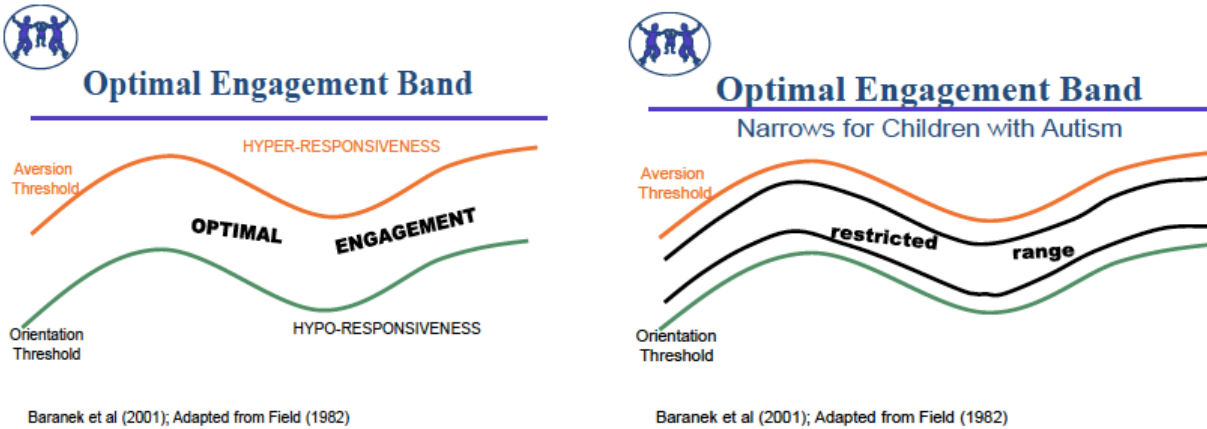


Figure 2.1. Optimal engagement band model for sensory processing in young children with autism

This study focuses on sensory regulatory features (i.e., hyporesponsiveness and sensory seeking behaviors) as components of early self-regulation. These features are of particular interest because they may contribute to better understanding the relationship between early self-regulation and joint attention skills. Both hyporesponsiveness and sensory seeking behaviors are known from previous research to be associated with language and social-communication skills in children with ASD (Baranek et al., 2013; Morales, Mundy, Crowson, Neal, & Delgado, 2005; Watson et al., 2011). Furthermore, orienting to social stimuli (i.e., response to name) has been named a critical precursor to joint attention because joint attention mediates the relationship between social orienting and language in preschoolers with ASD (Dawson, 2004).

The relationship between joint attention and sensory regulatory features has been previously explored by Baranek and colleagues (2013), who found that hyporesponsiveness was significantly negatively correlated with joint attention in a sample of children with ASD and developmental delay (DD), and that this correlation was stronger in younger children. Moreover, they found that in children with ASD, hyporesponsive behavior was negatively related to expressive and receptive language (Baranek et al., 2013). Furthermore, social orienting at 22

months of age has been found to mediate the association between sensory seeking behaviors at 22 months and social-communication symptom severity at 3-5 years old, while attention disengagement at 13 months of age predicted social orienting at 22 months, mediated by sensory seeking behaviors at 22 months (Baranek et al., 2017).

This study aims to expand upon the existing literature on the relationship between joint attention and early sensory regulatory features in children with ASD and examine how these pivotal skills affect later language and social-communication skills via analyses using extant data from a community sample of children who were identified as at-risk for ASD at 12 months of age via screening. Specifically, in line with the PDP Model (Mundy & Jarrold, 2011), the aims are to (1) examine the development of joint attention and sensory regulatory features using concurrent correlations and predictive regression models and to (2) determine the extent to which sensory regulatory features at 22 months mediate the relationship between joint attention at 13 months and general language outcomes versus social-communication outcomes at preschool age.

Though social and communication symptoms seem to aggregate into a single factor in children with ASD (Gotham, Pickles, & Lord, 2007), language skills are a related but independent construct. In fact, neurocognitive research suggests that communication and language processes are two different, yet interacting, systems (Willems et al., 2009) Language is the understanding and use of structural aspects of communication, including: what words mean (semantics), formulating words (morphology), putting words together into sentences (syntax), and assembling sounds in words for speaking, spelling and reading (phonology; ASHA 2017b). Social-communication is a broader construct that includes using language for different communicative functions (e.g., requesting, commenting), altering language to fit the social context, using social cognitive skills (e.g., Theory of Mind, Presupposition), and following the rules of conversation and

social interaction (ASHA, 2017a, 2017c). For this reason, determining how early joint attention and sensory regulatory features predict one another as well as later social-communication versus language outcomes may have implications for the timing of intervention strategies and the developmental construct in which change could be expected following those intervention strategies.

Method

This study aimed to examine the following research questions:

1. What are the concurrent and predictive correlations between joint attention and sensory regulatory features at 13 and 22 months of age in a community sample of children identified as at-risk for ASD at 12 months?
2. To what extent do joint attention and sensory regulatory features at 13 and 22 months predict general language outcomes in preschool in a community sample of children identified as at-risk for ASD at 12 months?
3. To what extent do joint attention and sensory regulatory features in children at risk for ASD at 13 and 22 months predict aspects of social-communication competence, including narrative retell ability in preschool, in a community sample of children identified as at-risk for ASD at 12 months?

Based on previous literature and the PDP Model, it was hypothesized that there would be significant concurrent and predictive correlations between early joint attention and sensory regulatory feature variables at 13 and at 22 months in cross lagged panel models. Moreover, it was anticipated that joint attention and sensory regulatory features at 22 months would predict language and social-communication skills in preschool but that different behaviors (e.g., joint

attention vs. sensory regulatory features) at 22 months may be more associated with different preschool outcomes. Specifically, previous literature (i.e., Baranek et al., 2013; Watson et al., 2011), supported a hypothesis that both joint attention and sensory regulatory skills at 22 months would be significant predictors of receptive and expressive language outcomes in preschool, but that sensory regulatory features at 22 months would account for more variance in social-communication outcomes in preschool than joint attention at 22 months. Finally, based on the findings of Baranek and colleagues' (2017) mediation models with the same at-risk sample used for this study, it was hypothesized that sensory regulatory features at 22 months mediate the predictive relationship between joint attention at 13 months and distal social-communication outcomes (i.e., narrative retell ability and social-communication symptom severity) in preschool. See figure 2.2 for conceptual model of these hypotheses.

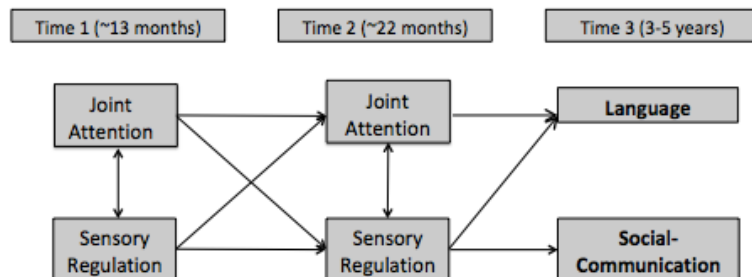


Figure 2.2. Conceptual model

Participants

Participants were drawn from the larger Early Development Project-2 (EDP-2), a randomized controlled trial (RCT) of a parent-mediated intervention (Watson et al., 2017). Children enrolled in EDP-2 were identified using the First Year Inventory (FYI; Baranek, Watson, Crais, and Reznick, 2003), which was mailed to parents in a 5-county catchment area of central

North Carolina based on birth records. Children met risk criteria for a future diagnosis of ASD based on cut-off scores in both sensory-regulatory and social-communication domains of the FYI. Ninety-seven eligible children, and a primary caregiver of each, participated in the first assessment (at ~13 months of age) and 87 of those families consented to randomization. Among randomized families, 84 completed post intervention assessments for EDP-2 (~22 months of age) and 48 of those participants returned for in-person behavioral assessments at a follow-up when the children were between 3 and 5 years old (see Figure 2.3).

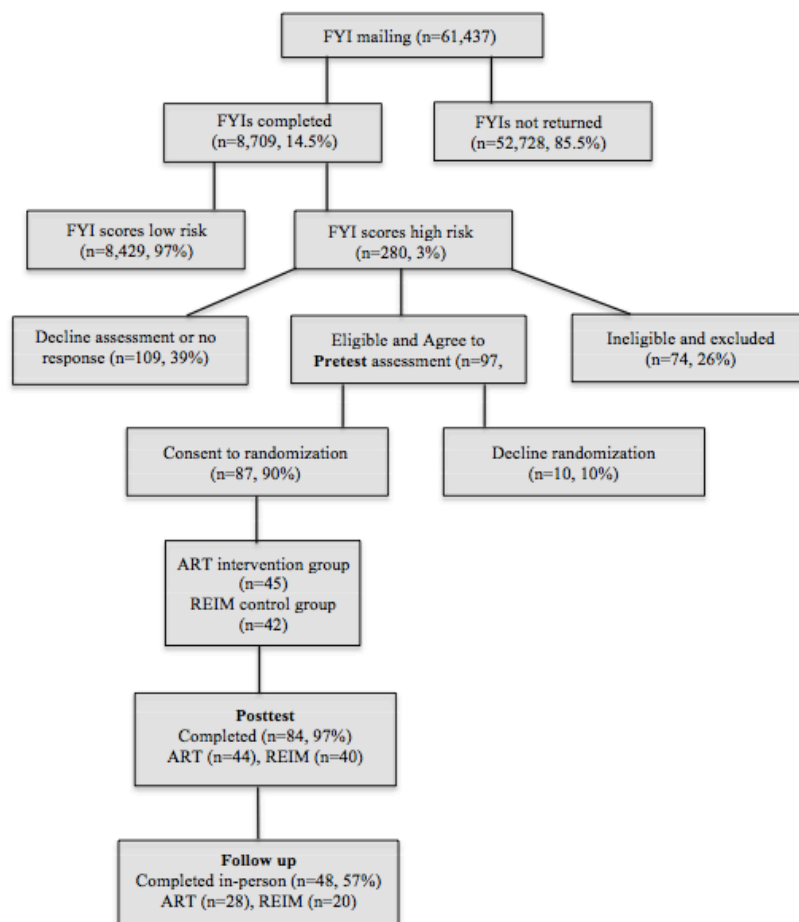


Figure 2.3. Flow chart of EDP-2 sample recruitment and retention; REIM = Referral to Early Intervention and Monitoring Control Group

The majority of children in this sample had average to above average cognitive abilities at the preschool follow-up assessments (Differential Ability Scales-2, Elliot, 2007; Mean = 103.37, s.d. = 13.58). Seventeen of the children seen for follow-up assessments were diagnosed with ASD (35%). Extant data for the 87 children who completed pre-intervention assessment and enrolled in the intervention phase of the RCT were used to address the first research question. Data from the 48 children who completed assessments at all three time points were used to address the 2nd and 3rd research questions about distal outcomes. Demographic characteristics of these samples can be viewed in Table 2.1. There were no significant differences in sex between children who returned for follow-up assessments in preschool and those who did not, $\chi^2(1,87) = .43$, $p \leq .51$, but there were significant differences found for race, $\chi^2(1,86) = 7.85$, $p \leq .01$, with fewer non-white families returning for follow-up than participated in the pre and post assessments. There were no significant differences found for measures of interest to this study (i.e., Sensory Processing Assessment and Communication and Symbolic Behavior Scales variables) between children who did and did not return for follow-up assessments. The intervention did not have any main effects on any of the variables included in the current analyses; however, treatment group was included in the initial models to test for potential influence of treatment group on results, and then removed from the final models if it had no significant effect.

Table 2.1 *Sample Demographic Information*

Sample Demographics					
<i>Time point</i>	<i>N</i>	<i>Chronological Age in Months</i>	<i>Developmental Quotient</i>	<i>Sex</i>	<i>Race</i>
		M (SD) Range	M (SD) Range		
At pretest	87	13.75 (0.72) 13 - 16	81.39 (14.63) 50-120	Female = 27 (31%)	Non-White = 26 (30%)
At follow-up	48	53.96 (11.06) 35-73	102.21 (15.97) 49-141	Female = 16 (33%)	Non-White = 8 (17%)

Developmental Quotient = Mullen Scales of Early Learning, Early Learning Composite for pretest and the Differential Ability Scales -2 General Conceptual Ability Standard Score for follow up. Note that two children at follow-up received the MSEL.

Instrumentation

Observational measure of joint attention. The *Communication and Symbolic Behavior Scales-Developmental Profile* (CSBS-DP; Wetherby & Prizant, 2002) is a standardized behavioral measure of early communication ability for children who are developmentally between 6 and 24 months old. It was administered to the EDP-2 sample at pre- and post-test assessments. The CSBS Behavior Sample includes three types of coded joint attention behaviors: (1) Gaze Shifts: coded as presence or absence of initiating joint attention during each of 6 presses, score range = 0-6; (2) Gaze/Point Follow: coded as the presence or absence of child attention shifts when the clinician uses eye gaze paired with pointing to share an object or event during 2 presses, actual score range = 0-2, but this scale is multiplied by 3 to be equally weighted with other scales on the CSBS, for a score range of 0-6; (3) Joint Attention: using verbal or nonverbal communication for the purpose of directing someone's attention to an object or event during each of 6 presses, score range = 0-6. For all of these variables, higher scores signify better, or more developmentally advanced, joint attention skills.

Note that since there are two initiation of joint attention items and only one response to

joint attention item, the composite Joint Attention variable used in the models for this study is more heavily weighted toward initiation of joint attention than response to joint attention. This is important to consider since response to joint attention behaviors in the PDP Model are conceptualized as rapid attention orienting to objects or events and less volitional than initiating joint attention behaviors, which are self-initiated and goal-directed uses of attention (Mundy & Jarrold, 2011). If the Joint Attention composite variable were weighted more toward response to joint attention items, a stronger correlation with the Sensory Regulation composite would be anticipated since delayed attention orienting is affected by both hyporesponsiveness and sensory seeking; however, due to the weight toward initiation of joint attention in this composite variable, only a moderate correlation between these variables is hypothesized.

Observational measure of sensory regulatory features. The *Sensory Processing Assessment* (SPA; Baranek, 1999a) is a play-based observational assessment designed to measure responses to sensory stimuli across three modalities (i.e., auditory, visual, tactile) in young children. Scores on the SPA are obtained for Hyperresponsiveness, Hyporesponsiveness, and Seeking behaviors. During the SPA administration, children are exposed to a variety of novel toys with sensory components (e.g., a toy blow fish with rubber spikes or a switch-activated fan shaped like an animal). While the child is engaged with a novel toy, the examiner introduces another sensory stimulus that is either non-social (e.g., a noise maker or a flashing light) or social (e.g., name call, shoulder tap). The child has three trials, or opportunities, to shift their attention away from the toy with which they are engaged and orient to the new sensory stimulus. Orienting is scored on a 1-4 scale with “1” indicating that the child oriented on the first trial, “2” oriented on the second trial, “3” oriented on the third trial, and “4” not orienting on any trial. The Hyporesponsiveness score on the SPA is the mean Orienting score during trials of seven different

sensory stimuli. Higher scores indicate greater difficulty with orienting to sensory stimuli.

Throughout the 20-30 minute SPA administration, the examiner notes all stereotyped behaviors demonstrated by the child (e.g., arm or hand flapping, mouthing non-food objects). There are eight total stereotypies scored on the SPA as present ("Yes") or absent ("No"). "Yes" is scored as a "1" and the sum of the stereotypies creates the Seeking score, where higher scores indicate more sensory seeking behaviors observed during the SPA.

SPA Hyporesponsiveness has been associated with social-communication symptom severity (Watson et al., 2011) and poorer joint attention abilities (Baranek et al., 2013). SPA Sensory Seeking behaviors also have been found to be significantly correlated with social communicative symptom severity for children with ASD, but not for children with other developmental disabilities (Watson et al., 2011). Moreover, in the EDP-2 sample, SPA Sensory Seeking behaviors at 20-24 months were found to significantly predict social-communication symptom severity on the ADOS-2 in the preschool years and this relationship was mediated by social orienting at 20-24 months (Baranek, et al., 2017). SPA Hyperresponsiveness has been less sensitive to differences between ASD and other disability groups (Brock, Freuler, Baranek, Watson, Poe, & Sabatino, 2012), and has not been systematically related to social-communication features of ASD (Watson et al., 2011). Thus, hyporesponsiveness and sensory seeking were of greater interest for these analyses than hyperresponsiveness.

Observational preschool language and social-communication outcome measures.

The *Preschool Language Scales- Fifth Edition* (PLS-5; Zimmerman, Steiner, & Pond, 2011) is a standardized structured behavioral assessment of developmental language skills in English-speaking children from 2-7 years of age. It was administered to all children at follow up (n = 47). Standard Scores on the two language scales: Auditory Comprehension (sample M=102.38,

s.d.= 17.01) and Expressive Communication (sample M = 102.23, s.d. = 17.81), were used to address research question 2.

A narrative retell task from the PLS-5 was administered to all children in the study at follow up (n = 48) and was used as a distal social-communication outcome in the analyses for this study. Narrative retell skills are considered to reflect social-communication more than language because recounting events is an important aspect of conversation that requires skills beyond the scope of structural language such as topic maintenance, event sequencing, coherence, and presupposition (ASHA, 2017c). Stories were audio recorded and transcribed by a trained undergraduate research assistant for analyses. Story retell tasks are considered useful measures of language competence (Ketelaars, Jansonius, Cuperus, and Verhoeven, 2009) that are easier to score reliably than story generation tasks (Merritt & Liles, 1989). Heilmann, Miller, & Nockerts (2010) compared four story retell analysis measures and concluded that the Narrative Scoring Scheme (NSS) was most sensitive for children ages 5-7 years. The NSS, as detailed in Heilmann et al. (2010), was the narrative retell analysis coding system used in the current study. Using training materials available on the SALT website (Miller, Andriacchi, & Nockerts, 2018), a research assistant and the study PI established reliability using the seven NSS items (Introduction, Character Development, Mental States, Referencing, Conflict Resolution, Cohesion, Conclusion). Items were rated on a scale from 0-5 with higher scores reflecting more mature narrative skills and summed to form a total narrative retell ability score (range 0-35). Scores of “0” were assigned when children refused to participate (e.g., said “all finished” or “I can’t do it,” didn’t respond, conversed with examiner about other topics). Inter-rater reliability was acceptably high (ICC= .81) for coding the NSS in this sample. The total NSS score was used in analyses to address research question 3 (sample Mean = 5.27, s.d. = 6.04).

The Autism Diagnostic Observation Scale- Second Edition (ADOS-2; Lord et al., 2012) is a semi-structured standardized behavioral measure of ASD symptoms. It was administered to all EDP children at follow-up ($n = 45$) using the module that aligned with their language level. The ADOS was administered by either a research reliable speech-language pathologist or a psychology graduate student who was supervised by a research reliable licensed psychologist. The Social Affect Calibrated Severity Score (Hus, Gotham, & Lord, 2012) is a standardized domain score that is calculated from the ADOS Social Affect raw score from each respective ADOS module, and allows social-communication symptom severity comparison across ADOS modules (i.e., controlling for developmental level). Since children in the EDP2 sample received different modules of the ADOS, the Social Affect Calibrated Severity Score was used as a measure of social-communication symptom severity to answer question 3. Scores ranged from 1-10 with higher scores indicating greater social-communication symptom severity (sample Mean = 3.78, s.d. = 2.57).

See Figure 2.4 for variables targeting each construct of interest by time point in cross-lagged model.

Procedures

All assessments for the EDP-2 study were administered either in a university clinic setting or at another outpatient pediatric clinic (e.g., Children's Developmental Services Agency). Assessments used for the present analyses were part of larger behavioral assessment protocols lasting 2-3 hours. Study procedures were approved by the Institutional Review Board at the University of North Carolina at Chapel Hill. Informed parental consent was obtained for all participants. Study analyses were completed using JMP Pro version 13.0 (JMP, 2007) and Mplus version 7.4 (Muthen & Muthen, 2015).

First, composite variables were established for the two constructs of interest: Joint Attention and Sensory-regulation. Composite variables were empirically tested through examination of variable distributions, correlations, principal components analyses, and exploratory factor analyses. Variable distributions were examined for skewness, kurtosis, and heteroscedasticity (Table 2.2). For the CSBS, distributional irregularities were observed and one variable (joint attention) had more restricted variability compared to the other two. To control for this finding, the CSBS variables were run as ordinal variables for the exploratory factor analyses. Correlations between the individual variables (Table 2.3) were also examined.

Table 2.2

<i>CSBS and SPA Individual and Composite Variable Distributions</i>		
Construct	Time 1 (n=87)	Time 2 (n=82)
	Mean (SD)	Mean (SD)
	Range	Range
<i>Communication and Symbolic Behavior Scales (CSBS)</i>		
Gaze Shift	5.57 (.88) 2-6	5.42 (1.06) 1-6
Gaze-Point-Follow	4 (1.98) 0-6	5.38 (1.47) 0-6
Joint Attention	1.87 (1.87) 0-6	3.34 (1.85) 0-6
Composite Joint Attention	3.82 (1.20) .67-6	4.71 (1.17) .33-6
<i>Sensory Processing Assessment (SPA)</i>		
Sensory Seeking	2.63 (.84) 1-4.43	2.59 (.89) 1-4.43
Hyporesponsiveness	2.31 (.85) 1-5	2.17 (.67) 1-3.66
Composite Sensory-Regulation	2.47 (.63) 1.29-4.43	2.38 (.64) 1-3.93

Table 2.3

Correlation Matrix

	T1 Gaze Shift	T1 Gaze- Point- Follow	T1 Joint Attention	T1 Hypo	T1 Seek	T2 Gaze Shift	T2 Gaze- Point- Follow	T2 Joint Attention	T2 Hypo	T2 Seek
T1 Gaze Shift	1.00	.42**	.34**	-.29*	-.32*	.53**	.52**	.34**	-.42**	-.24*
T1 Gaze- Point- Follow		1.00	.46**	-.48**	-.15	.16	.35*	.25*	-.15	-.18
T1 Joint Attention			1.00	-.21	-.23*	.25	.58**	.29*	-.13	-.31*
T1 Hypo				1.00	.11	-.14	-.40**	-.23*	.27*	.25*
T1 Seek					1.00	.08	-.05*	.20	-.14	-.16
T2 Gaze Shift						1.00	.32**	.69**	-.33**	-.35**
T2 Gaze- Point Follow							1.00	.44**	-.62**	-.58**
T2 Joint Attention								1.00	-.31**	-.43**
T2 Hypo									1.00	0.36**
T2 Seek										1.00

** Significant at .01 alpha level; * Significant at .05 alpha level; T1= time 1/Pretest, T2= time 2/Posttest. Note that since the CSBS variables (Gaze Shift, Gaze-Point-Follow, and Joint Attention) were ordinal variables, intercorrelations with these variables are polychoric correlations. Polyserial correlations are reported between SPA (Hypo and Seek) and CSBS variables. Pearson correlations are reported for intercorrelations on the SPA since these variables were continuous.

Exploratory factor analyses were used to (1) empirically test the constructs, (2) see whether it was worthwhile to use factor analytic scores rather than variable composite scores in the models, and (3) to determine if the factor structure was consistent across measurement time points for Joint Attention and Sensory-regulation (i.e., if measurement invariance holds). Results of the exploratory factor analyses combined with the results of the principal components analyses indicated that the individual joint attention and sensory regulatory variables were empirically valid to combine into composite variables. Measurement invariance held for the Sensory-regulation construct, but only partial measurement invariance held for the Joint Attention construct. Because the Sensory-regulation construct only consisted of two variables from the SPA, requiring a

constrained factor analytic model, coupled the lack of full measurement invariance for the Joint Attention construct, it was not obvious what the optimal linear construct would be for use of factor analytic scores in the models; therefore, the composite variables, constructed as means of their constituent variables, were used in the cross-lagged models. The Sensory-Regulation (SR) composite is a mean of the SPA Hyporesponsiveness and SPA Seeking variable scores. The Joint Attention (JA) composite is a mean of the three CSBS joint attention item scores. Composite variables at each time point were approximately normally distributed (see distributions in Table 2.2). As expected, correlations between composite variables at each time point were statistically significant (Table 2.4).

Table 2.4
Pearson Correlations between Composite Variables at Each Time Point

	T1 JA	T1 SR	T2 JA	T2 SR
T1 JA	1.00	-.44**	-.41**	-.31**
T1 SR		1.00	-.24*	.32**
T2 JA			1.00	-.58**
T2 SR				1.00

** Significant at .01 alpha level; * Significant at .05 alpha level; T1 = pre-test, T2 = post-test, JA = Joint Attention, SR = Sensory-regulation

Full information maximum likelihood estimation was used in all models to accommodate missing data on proximal as well as distal measures. Cross-lagged panel correlations were examined to determine the bidirectional effects between joint attention and self-regulation at 13 and 22 months (Figure 2.4). This method simultaneously tested (1) joint attention at 13 months predicting sensory-regulation at 22 months while controlling for sensory-regulation at 13 months; and (2) sensory-regulation at 13 months predicting joint attention at 22 months while controlling for joint attention at 13 months. The model was reduced through a principled model reduction

strategy using a series of model comparisons to determine the most parsimonious set of predictors for the data (Applebaum & Cramer, 1974; Cramer & Applebaum, 1980).

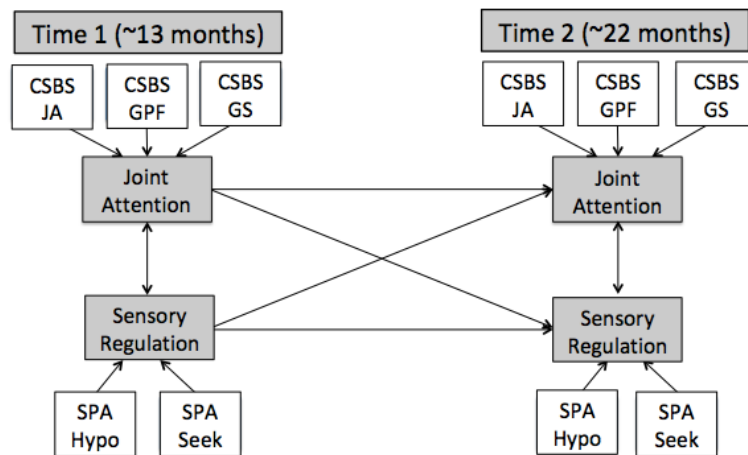


Figure 2.4. Cross lagged panel model

Note: CSBS = Communication and Symbolic Behavior Scales; JA = Joint Attention; GPF = Gaze Point Follow; GS = Gaze Shift; Hypo = Hyporesponsiveness; Seek = Sensory Seeking

The distal language and social-communication outcomes from the third (preschool) EDP-2 study time point were added to the final cross-lagged panel correlation analysis model from question 1. First, models were run to address research question 2, by adding the PLS Receptive and Expressive Language scores from time 3 as distal outcomes. Next, models were run to address research question 3, by adding the ADOS Social Affect Calibrated Severity Scores and NSS Total Scores from time 3 as distal outcomes. These models allowed examination of the extent to which the direct effects of joint attention and sensory-regulation variables at 22 months as well as the indirect effects of those variables at 13 months predict various aspects of communication competence in preschool. Finally, mediation models were run to determine if sensory-regulation skills at 22 months mediated the predictive relationship between joint attention at 13 months and language and social-communication outcomes in preschool, as hypothesized.

Despite the lack of main effects of the intervention in the EDP-2 study (Watson et al., 2017), a categorical intervention group variable was included in the initial models to account for the potential influence of intervention on outcomes. Furthermore, there was a broader time gap between post-test and follow up assessments (Mean gap = 31.53 months, s.d. = 11.34) than pre and post-tests assessments (Mean gap = 8.79 months, s.d. = .97), and there was much greater age variability at follow-up (i.e., children's ages spanned a 3-year range at follow up as compared to 3-5 month ranges at pre- and post-test assessments, respectively). Chronological age at follow up was included in the models addressing distal outcomes as a covariate to control for this variability in age.

Results

To determine the concurrent and predictive relationship between joint attention and sensory-regulation at 13 and 22 months in this sample of children at-risk for ASD, a cross-lagged panel model was run. The initial model (Figure 2.5a) supported the hypothesis that joint attention and sensory-regulation were related in early childhood. All concurrent correlations between joint attention and sensory regulatory features were significant in this model, as were predictive relationships between joint attention from 13 to 22 months and sensory regulatory features from 13 to 22 months. Intervention group was not a significant predictor of either joint attention or sensory regulatory features at 22 months, so it was dropped from the model. Although joint attention at 13 months significantly predicted both joint attention and sensory-regulation at 22 months, the predictive relationship between sensory-regulation at 13 months and joint attention at 22 months was not statistically significant. Therefore, this predictor was dropped from the final model (Figure 2.5b). The final cross lagged panel correlation model was used to estimate the relationships

between joint attention and sensory regulatory features at 22 months and distal language and social-communication outcomes at preschool follow up.

The final model indicates that joint attention skills at 13 months of age in this sample of children identified as at-risk for ASD were associated with both joint attention and sensory regulatory features at 22 months of age. In partial contrast, sensory regulatory features at 13 months are predictive of later sensory regulatory features, but not joint attention skills, at 22 months.

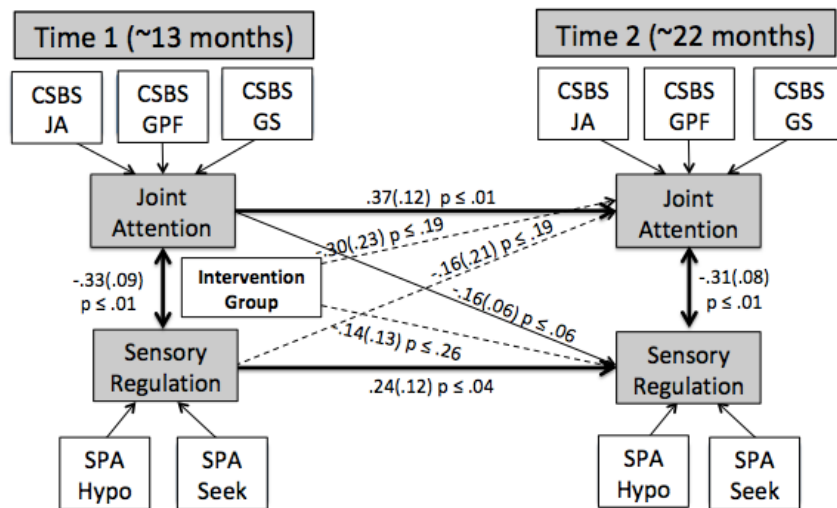


Figure 2.5a. Question 1: Initial cross lagged model

*Solid Bold Lines indicate statistical significance at a .05 alpha level; Solid Thin Lines indicate statistical significance at a .10 alpha level; Dashed Thin Lines indicate p value $\geq .10$.

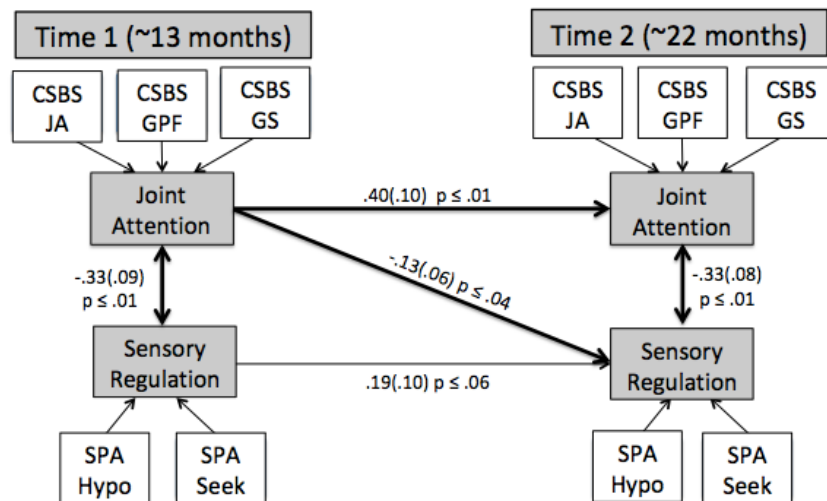
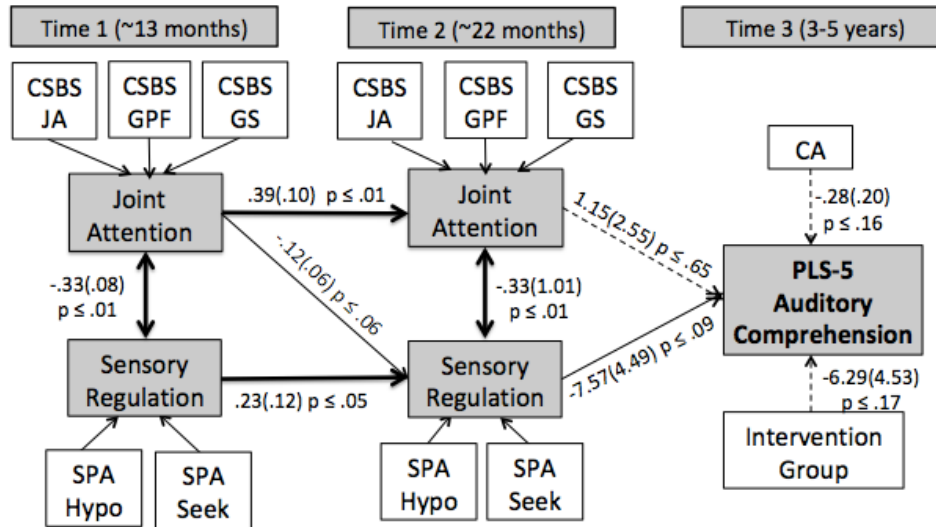


Figure 2.5b. Question 1: Final cross lagged model

Distal Language Outcomes

Receptive Language. The Auditory Comprehension standard score from the PLS-5 was added to the cross-lagged model as a distal receptive language outcome measure. The full model with chronological age and intervention group covariates is in Figure 2.6a. In this model, there were no significant correlations found between sensory regulatory features or joint attention skills at 22 months and child receptive language at preschool follow up; however, sensory-regulation approached significance. Since intervention group was not a significant predictor in the model, it was dropped.



*Solid Bold Lines indicate statistical significance at a .05 alpha level; Solid Thin Lines indicate statistical significance at a .10 alpha level; Dashed Thin Lines indicate p value $\geq .10$.

Figure 2.6a. Initial model with auditory comprehension as a distal outcome of the cross lagged panel analysis

The model was further reduced through a series of model comparisons. The final and most parsimonious model (Figure 2.6b) shows that sensory regulatory features at 22 months was the only variable needed in the model predicting receptive language skills at preschool follow up. Though joint attention was critical at 13 months for predicting joint attention at 22 months, joint attention at 22 months was not needed to predict receptive language in preschool in the presence of sensory-regulation.

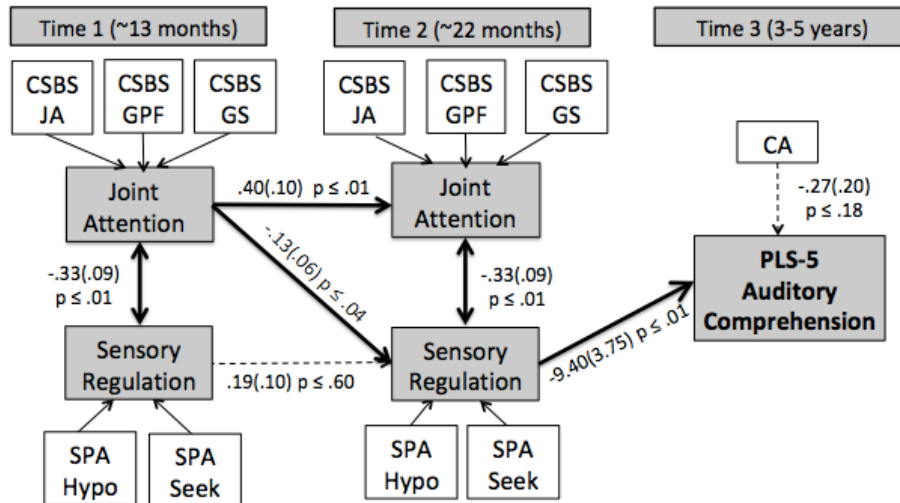
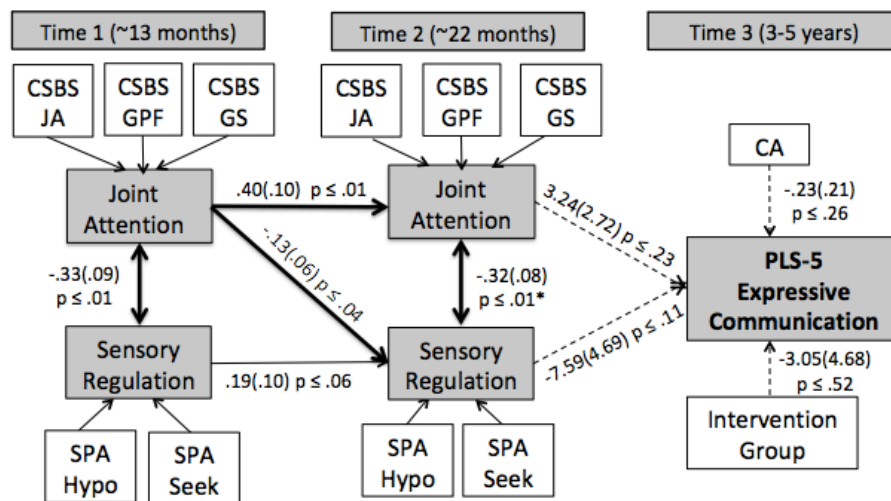


Figure 2.6b. Final model with auditory comprehension as a distal outcome of the cross lagged panel analysis

Expressive Language. The Expressive Communication standard score from the PLS-5 was used as a distal outcome measure of expressive language in the model. The full model with covariates (Figure 2.7a) demonstrated similar results to the Auditory Comprehension model. Neither joint attention nor sensory regulatory features significantly predicted expressive communication on the PLS-5 when controlling for intervention group and chronological age. Sensory-regulation at 22 months accounted for more of the variance in preschool Expressive Communication than did joint attention. Intervention group was dropped from the final model since it was not a significant predictor.

A series of model comparisons were used in an effort to further reduce the model to its most parsimonious form. The models were inconclusive because results were contradictory. In the absence of sensory-regulation at 22 months (Figure 2.7b), joint attention at 22 months significantly predicted Expressive Communication in preschool; however, in the absence of joint attention at 22 months (Figure 2.7c), sensory-regulation also was a significant predictor of preschool Expressive

Communication. Neither variable at 22 months was significant in the presence of the other, indicating that the significant correlation between these variables at 22 months caused each one to suppress the effects of the other.



*Solid Bold Lines indicate statistical significance at a .05 alpha level; Solid Thin Lines indicate statistical significance at a .10 alpha level; Dashed Thin Lines indicate p value $\geq .10$.

Figure 2.7a. Initial model with expressive communication as a distal outcome of the cross lagged panel model

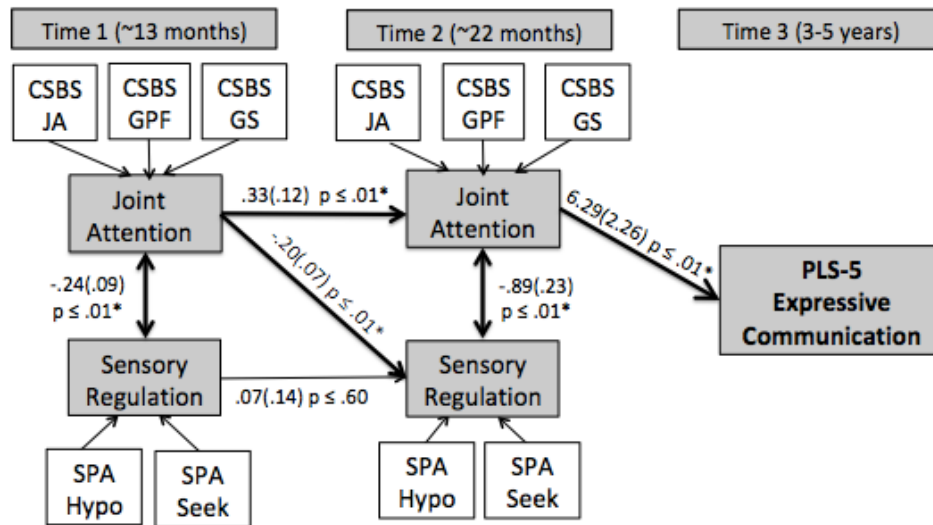


Figure 2.7b. Reduced model 1 with expressive communication as a distal outcome of the cross lagged panel analysis

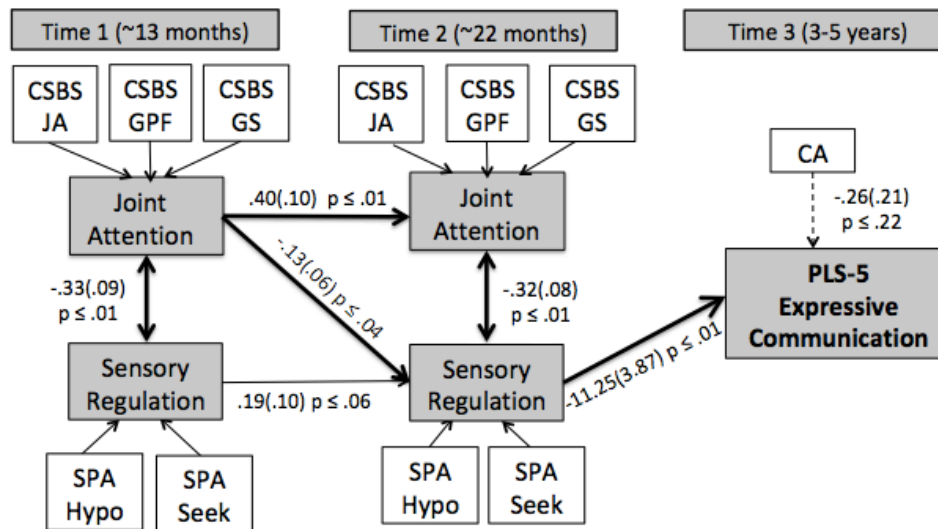


Figure 2.7c. Reduced model 2 with expressive communication as a distal outcome of the cross lagged panel analysis

Mediation models were run to determine if the significant relationships between variables from time 1 to time 3 were mediated by variables at time 2. For the PLS-5 Auditory

Comprehension outcome variable, a model was run to explore if sensory-regulation mediated the relationship between joint attention at time 1 and auditory comprehension at time 3 (see Figure 2.8). Despite joint attention at time 1 being a significant predictor of sensory-regulation at time 2, and sensory-regulation at time 2 being a significant predictor of auditory comprehension at time 3, the mediation model was not statistically significant. This result indicates that joint attention at time 1 is not critical to the distal outcome of receptive language in preschool.

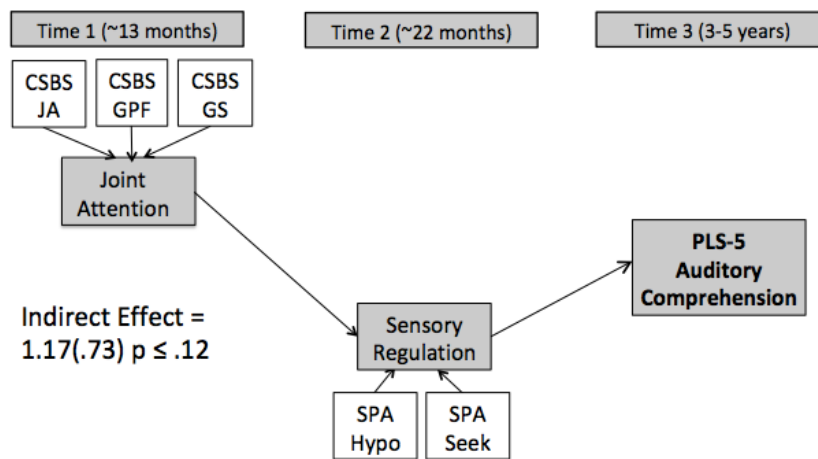


Figure 2.8. Indirect effect of joint attention at time 1 on auditory comprehension at time 3 mediated by sensory regulatory features at time 2

For Expressive Communication, a mediation model was run to determine if the relationship between joint attention at time 1 and Expressive Communication at time 3 was mediated by sensory-regulation at time 2. This model was marginally significant ($p \leq .09$; Figure 2.9a). Next, a model was run with joint attention at 22 months mediating the relationship between joint attention at 13 months and Expressive Communication in preschool. This model was statistically significant (Figure 2.9b). These models support the original cross-lagged results that both joint attention and

sensory-regulation are important skills at 22 months in the path of development between joint attention at 13 months and Expressive Communication in preschool.

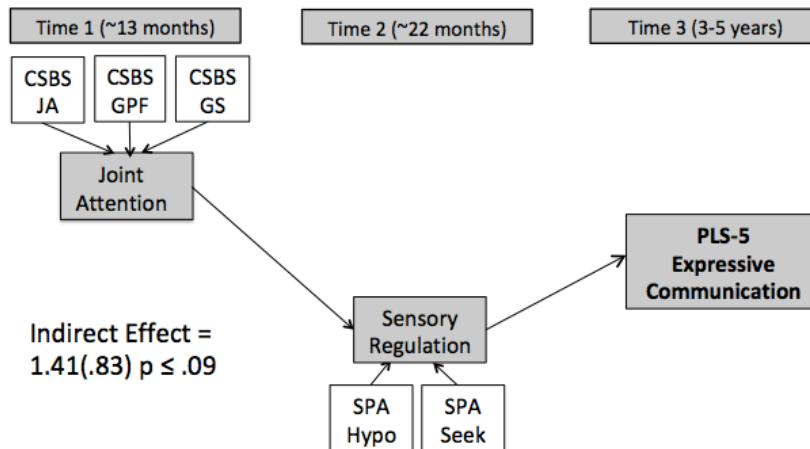


Figure 2.9a. Indirect effect of joint attention at time 1 on expressive communication at time 3 mediated by sensory regulatory features at time 2

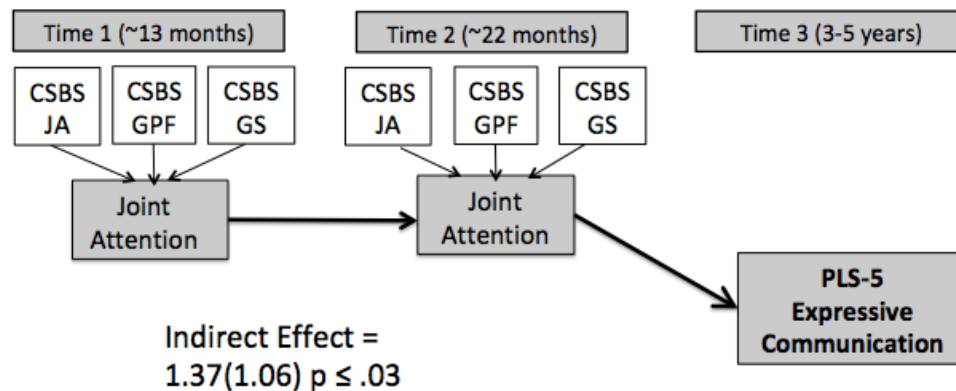
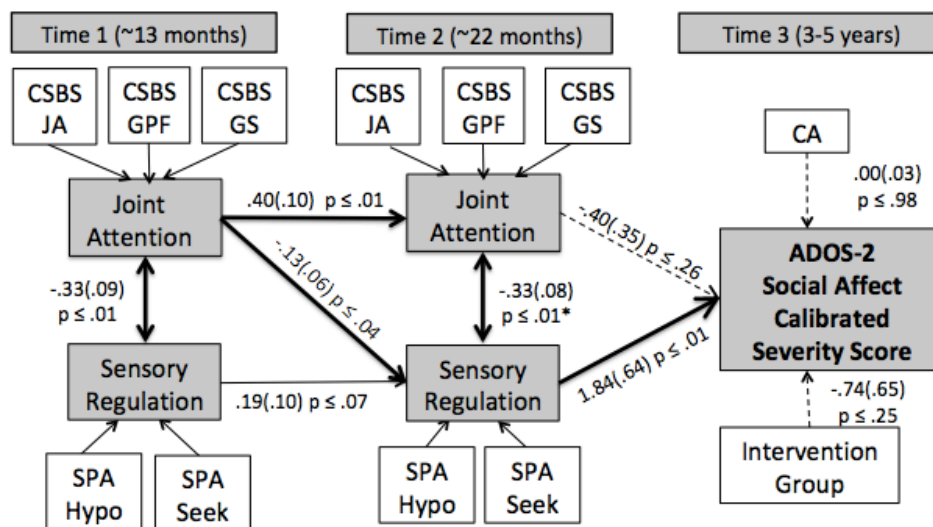


Figure 2.9b. Indirect effect of joint attention at time 1 on expressive communication at time 3 mediated by joint attention at time 2

Distal Social-Communication Outcomes

Social-communication symptom severity. The ADOS-2 Social Affect Calibrated Severity Score was used in the model as a distal outcome measure of social-communication symptom severity. In the full initial model (Figure 2.10a), sensory-regulation at 22 months is a significant predictor of the social-communication symptom severity in preschool, but joint attention at 22 months is not. This result held throughout the model reduction process and the final model can be seen in Figure 2.10b.



*Solid Bold Lines indicate statistical significance at a .05 alpha level; Solid Thin Lines indicate statistical significance at a .10 alpha level; Dashed Thin Lines indicate p value $\geq .10$.

Figure 2.10a. Initial model with ADOS-2 social affect calibrated severity score as a distal outcome of the cross lagged panel analysis

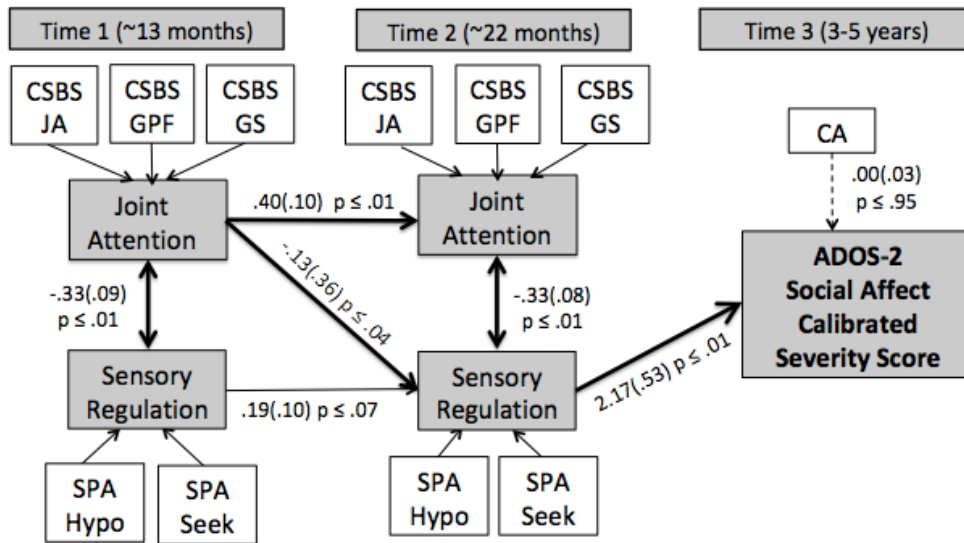
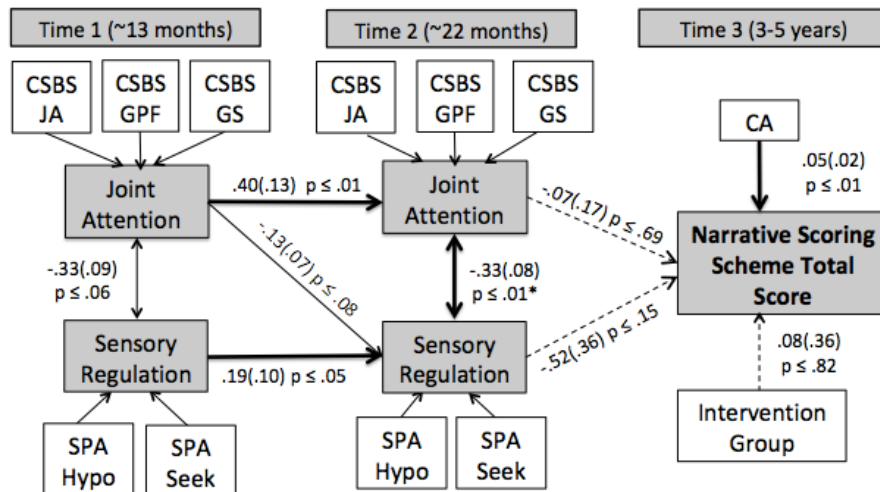


Figure 2.10b. Final model with ADOS-2 social affect calibrated severity score as a distal outcome of the cross lagged panel analysis

Narrative Retell. The Narrative Scoring Scheme (NSS) total score was used as a distal outcome measure of pragmatic language ability in the model. This outcome variable differed from the others in that it was not standardized. Since the sample was chronologically and developmentally at the lowest end of being able to complete a narrative retell task, scores were positively skewed. To account for the non-normal distribution, the NSS was run as negative binomial count variable in the model. The full model is displayed in Figure 2.11a where chronological age is the only significant predictor of NSS. This relationship remained the only significant predictor of narrative retell ability throughout model reduction procedures and the final model reflects this finding (Figure 2.11b) that neither joint attention nor sensory regulatory features at 22 months were significant predictors of narrative retell ability in preschool.



*Solid Bold Lines indicate statistical significance at a .05 alpha level; Solid Thin Lines indicate statistical significance at a .10 alpha level; Dashed Thin Lines indicate p value $\geq .10$.

Figure 2.11a. Initial model with NSS total score as a distal outcome of the cross lagged panel analysis

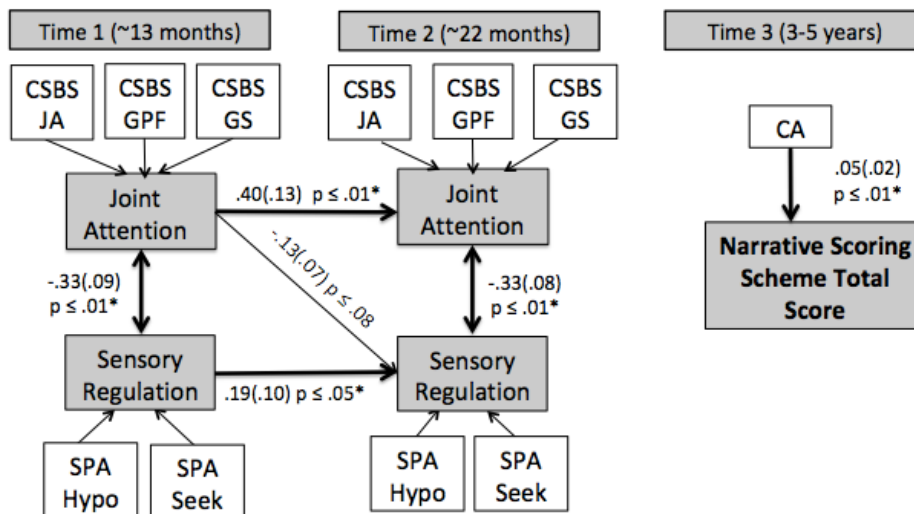


Figure 2.11b. Final model with NSS total score as a distal outcome of the cross lagged panel analysis

A mediation model was run to determine if sensory-regulation at 22 months mediated the relationship between joint attention at 13 months and social-communication symptom severity in preschool. This model approached statistical significance ($p \leq .06$; see Figure 2.12).

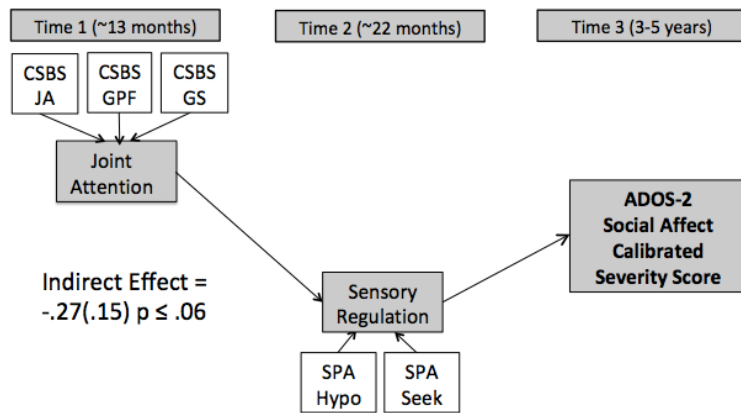


Figure 2.12. Indirect effect of joint attention at time 1 on social affect calibrated severity score at time 3 mediated by sensory regulatory features at time 2

Overall, results of the models run to determine the extent to which joint attention and sensory regulatory features predict social-communication outcomes in preschool indicate that sensory-regulation at 22 months is a significant predictor of social-communication symptom severity in preschool.

Discussion

This study employed cross-lagged panel correlation analysis methods to (1) examine the concurrent and predictive relationships between joint attention and early sensory regulatory features between 13 and 22 months of age in a sample of children identified as at-risk for ASD at 12 months, (2) determine the extent to which joint attention and early sensory regulatory features

at 13 and 22 months predict distal language and social-communication outcomes at 3-5 years. The final model for the first study aim confirmed the initial hypothesis and findings from Baranek and colleagues (2013) that there were significant concurrent relationships between the joint attention and sensory regulatory constructs at 13 and 22 months and predictive relationships between each construct from 13 to 22 months. Interestingly, joint attention at 13 months was the only variable needed in the model to predict both joint attention and sensory regulatory features at 22 months and the sensory regulatory construct at 13 months was dropped from the final model. Results indicate developing joint attention skills at 13 months may benefit the domains of both joint attention and sensory-regulation at 22 months, whereas sensory regulation at 13 months may have a less significant impact on outcomes in these constructs at 22 months.

To address the second and third aims of this study, the cross-lagged panel correlation model was extended to predict individual distal language and social-communication outcomes in the sample at preschool age. Receptive language skills in preschool were best predicted by a cross-lagged panel model with sensory regulatory features at 22 months as the only predictor. This model suggests that, for children similar to this sample, sensory-regulation may be a critical developmental domain to address at 22 months in order to impact receptive language outcomes between 3 and 5 years of age.

The models for preschool expressive language provided a less definitive conclusion than those for receptive language in that both joint attention and sensory regulatory features at 22 months were significant predictors of outcome, but one suppressed the other when they were both in the model. Tentatively, addressing either joint attention or sensory regulation as intervention targets at around 22 months may improve later outcomes on expressive language, but addressing both simultaneously may be inefficient. Further, the models of indirect effects suggest that if

expressive language were the primary intervention goal at 22 months (e.g., in the instance where other skills were developing typically at 22 months), promoting joint attention may be more effective than promoting sensory-regulation at 22 months.

Taken together, the distal language outcome models examined for question 2 suggest that that sensory regulatory features at 22 months are critical for predicting later receptive language outcomes in preschool. For expressive language outcomes, results are less clear. It seems that either development of sensory-regulation or joint attention at 22 months has benefits for later expressive communication. Based on models of indirect effects, joint attention at 13 months is critical to the development of later expressive language (mediated by sensory-regulation at 22 months), but joint attention at 13 months is not critical for receptive language development in preschool. In light of these results, improved sensory-regulation at 22 months , specifically reducing hyporesponsiveness and sensory seeking, may be most advantageous for impacting both receptive and expressive language outcomes at preschool age. In young children at-risk for ASD, such as those in this study, it is possible that targeting sensory-regulation in early intervention, specifically hyporesponsiveness and seeking behaviors, at 22 months will have a greater impact on both receptive and expressive language outcomes than targeting joint attention skills. Thus, sensory regulation may play an especially important role for improving language outcomes for children who are showing early delays in both the receptive and expressive language modalities. This theory requires testing in the context of a future early intervention study since results from this study only establish a developmental sequence of skills for this sample.

Similar to receptive language, social-communication symptom severity in preschool was best predicted by a cross-lagged panel correlation model with sensory regulatory features at 22 months as the only predictor. Moreover, sensory regulatory features at 22 months mediated the

association between joint attention at 13 months and social-communication symptom severity in preschool, demonstrating a clear path of developmental timing for toddlers at-risk for ASD to have an impact of social-communication symptom severity in preschool, suggesting that supporting the development of joint attention at 13 months and sensory-regulation at 22 months may be the most beneficial sequence for optimizing social-communication outcomes in preschool.

Narrative retell skills in preschool did not demonstrate any association with joint attention or sensory regulatory features at 22 months and were only predicted by chronological age. This lack of association may be because this measure is not standardized, and because preschool-aged children were scoring at the lowest end of the measure, which limited score variability (sample mean = 5.27, NSS total score range = 0-35). Unfortunately, it is difficult to draw conclusions about these narrative scores in preschool-aged children at-risk for ASD, because most studies of narrative ability in children with ASD have consisted of samples aged 6.5 years or older (Biaxauli, Colomer, Rosello, & Miranda, 2016). In a review of 24 studies with older children diagnosed with ASD compared to typically developing children, Biaxauli and colleagues (2016) found that children with ASD struggled with narrative cohesion, referencing, use of emotional state words, and general difficulty “seeing the big picture” relative to age-matched typically developing peers. Moreover, a recent study of preschool narrative ability in verbal children with ASD (Westerveld & Roberts, 2017) extended the findings of studies with older children in that the preschoolers with ASD told less coherent narratives with fewer events, but had generally good sentence structure relative to typically developing preschoolers. Unfortunately, only 19 of the 29 children (66%) in the Westveld and Roberts study produced codeable narratives, while the other children refused the task, told a different story, or attempted to retell the story but didn’t produce meaningful utterances. Child participation in narrative retelling was not related to overall language level or

cognitive level (Westerveld & Roberts, 2017). This finding is similar to the present study where only 28 of the 49 (57%) of the children (including some children who were less verbal than in the Westerveld & Roberts study) produced codeable narratives. Considering previous literature and the current results, it is possible that narrative retell skills in preschool, as measured by currently available assessment instruments and protocols, is not a stable or valid construct. Future research should explore modified assessment protocols to elicit narratives from preschool children with or at-risk for ASD (Westerveld & Roberts, 2017) since narrative retell skills have been shown to predict later language and literacy outcomes (Bishop & Edmundson, 1987; Bishop & Adams, 1990).

The results from the distal preschool language and social-communication outcome models suggest that joint attention and sensory regulatory features are significantly related constructs in early childhood development that have cascading effects on some important aspects language and social-communication in preschool (i.e., receptive language, expressive language, and social-communication symptom severity). These results support and expand upon previous literature. Baranek (2013) found that hyporesponsiveness to both social and non-social stimuli was related to deficits joint attention skills in children with autism, developmental delay, and typical development. The current study replicated that finding over two time periods of early childhood for toddlers at-risk for ASD using a composite self-regulation variable that included hyporesponsiveness. Watson and colleagues (2011) found a positive association between sensory seeking behaviors and social-communication symptom severity in children with ASD, which did not hold for children with developmental delay. The present study found this same association between a composite sensory regulatory variable, which included sensory seeking, and social-communication symptom severity in preschool. Both groups of children in the Watson (2011)

study showed a negative correlation between hyporesponsiveness and language. This relationship was replicated in the present study and lower levels of hyporesponsiveness (i.e., better orienting responses) at 22 months were shown to predict greater receptive and expressive language skills in preschool.

Taken together, results of this study suggest that, for optimal outcomes in both language and social-communication at preschool age, joint attention may be the best skill to target at 13 months, while sensory regulation may be the preferred intervention target at 22 months. These findings may have implications for future early childhood intervention research for children at-risk for ASD. If the advantages of this sequence and timing of intervention targets compared to alternatives are empirically verified, such findings would help clinical teams and families determine where to focus their time and energy to achieve the best language and social-communication outcomes. For instance, rather than receiving treatment in both of these developmental domains simultaneously, families could focus on targeting joint attention skills for the first year and then switch to targeting sensory-regulation by age two, or when the child has mastered their joint attention goals. It is possible that knowing where to focus their time and intervention efforts may alleviate some of the stress associated with early identification of ASD symptoms for parents by giving them a prescribed plan of treatment.

There were some limitations to this study. First, the variables chosen for analysis in this study are somewhat limited by the use of extant data; however, the extant data made it possible to conduct a preliminary investigation of these longitudinal models to help guide future studies. Future prospective studies should use a more direct measure of joint attention rather than extracting items from a larger measure (e.g., the Joint Attention Protocol; Watson, Poston, & Baranek, 2003; see Nowell, Watson, Faldowski, & Baranek, 2018). Regarding sensory regulatory

features, this study only examined hyporesponsiveness and sensory seeking features. With a larger sample it may be interesting to explore these models with hyperresponsivity to ensure that the hyperresponsive aspect of sensory-regulation is not contributing to language and social-communication outcomes, as suggested by previous literature, and to look at differences between hyper- and hyporesponsivity models.

There was no comparison group of children who were not identified as at-risk for ASD in this study. Having a control group would allow comparison of these models to children who were not at-risk and provide insight into whether the results hold for the general population of toddlers or are unique to this at-risk population. It would also be beneficial to look at toddlers (1) who were identified as at-risk for ASD on different screening tools (e.g., Modified Checklist for Autism in Toddlers; Robbins, Fein, & Barton, 2009) and (2) who were identified based on familial/genetic risk to see if the results are replicable. Moreover, these models of social-communication and sensory regulatory features have yet to be explored in typically developing toddlers and those with other developmental disabilities and may be another important future research direction to determine the extent to which these findings are unique to toddlers at-risk for ASD. Finally, since this was a developmental study rather than an intervention study, intervention implications discussed in this paper are possible future research directions, which need to be tested in the context of an intervention study with a larger sample.

CHAPTER 3: EFFICACY STUDY OF THE GROWING LIVING AND LEARNING WITH AUTISM (GoriLLA) GROUP

Overview

This study examines the efficacy of an intervention targeting social-communication and self-regulation in 1st and 2nd graders (n = 17) diagnosed with Autism Spectrum Disorder (ASD) who are included in mainstream school settings and their parents. A randomized waitlist control group design with pre- and post- intervention assessments of both parents and children was implemented within a community practice setting to address the study aims. Overall, the results of this study indicate that the intervention is efficacious in teaching social-communication and self-regulation knowledge and skills to children with ASD and their parents. Both parents and children demonstrated an increase in social-communication and self-regulation knowledge and skills after participating in the Growing Living and Learning with Autism (GoriLLA) Group as compared to a waitlist control group. Furthermore, in applied written scenario responses, parents' use of GoriLLA Group strategies and vocabulary increased from pre to post test relative to the control group, though results were not statistically significant. The effects of the intervention did not extend to parent report of sensory responses in the children or to parent-child interactions, coded from video recordings. Based on parent report at the conclusion of the intervention, this is a socially valid intervention for teaching social-communication and self-regulation skills to early elementary school-aged children with ASD.

Introduction

In the United States, 1 in 68 children is affected by ASD (Christensen, 2016). Nearly half of children with ASD have average to above average cognitive ability (Christensen, 2016), yet their adult outcomes are poor compared to typically developing peers (Dijkhuis, Ziermans, Van Rijn, Staal, & Swaab, 2016; Howlin, Moss, Savage, & Rutter, 2013) and peers with ASD who have below average cognitive ability (Mordre et al., 2012). Autism symptom severity, adaptive functioning, and exposure to early intervention are all more predictive of positive adult outcomes in ASD than cognitive ability alone (Anderson, Liang, & Lord, 2013; Gray et al., 2014). Though average to above average cognition increases the chances that an individual with ASD will be employed, these individuals are less likely to be involved in activities outside of their homes than their peers with lower cognitive skills (Taylor & Seltzer, 2011). Social-communication and self-regulation are skill areas in which individuals with ASD struggle. Social-communication deficits have been shown to negatively impact academic performance (Welsh, Parke, Widaman, & O’Neil, 2001), be correlated with anxiety and depression (Barnhill, 2001), and affect social inclusion outcomes in adulthood including friendships and employment (Howlin et al., 2013). Self-regulation deficits, specifically emotion regulation and executive functioning difficulties, have been shown to negatively impact engagement in academic and social settings in children (Jahromi, Bryce, & Swanson, 2013) and are correlated with self-reports of lower quality of life compared to non-ASD peers in young adulthood (Dijkhuis et al., 2016).

Group interventions are common practice for treating social-communication skills in children with “high functioning” ASD, but evidence for the efficacy of these groups has been mixed (Rao, Beidel, & Murray, 2008). In 2010, Reichow and Volkmar completed a review of social skills group intervention studies for school aged children with ASD and concluded that

social skills groups met criteria (based on Reichow et al., 2008) to be an evidence-based practice for ASD. Interventions targeting self-regulation have been found to be efficacious for children with attention deficit hyperactivity disorder (ADHD; Reid, Trout, & Schartz, 2005) and learning disabilities (Reid, 1996) and have recently shown emerging evidence for groups of children with ASD (e.g., Stoesz, Montgomery, & MacKenzie, 2013). Though both social-communication and self-regulation are skill areas that predict outcomes for children with high functioning ASD and interventions targeting these skills have a promising evidence-base, no known intervention exists that addresses both of these skill areas. The purpose of this study is to examine the efficacy of an existing parent-assisted community intervention for children with ASD that targets both self-regulation and social-communication skills.

Community Based Research Methods

Though many researchers in the field of ASD share a common goal to develop interventions that can be effectively implemented in community practice settings, a lengthy evidence-to-practice gap persists. Controversy has arisen within the ASD research community regarding the best course by which to establish an evidence-base for an intervention and disseminate those practices to the community. A National Institute of Mental Health (NIMH) working group proposed a stepwise model for developing evidence-based psychosocial interventions for ASD (Smith et al., 2007). Though certainly this model serves as an important roadmap for the field, it has been argued that models like this one are too idealistic and that studying interventions within the community setting in which they will be delivered should start earlier in the research process in order to ameliorate the evidence-to-practice gap (Dingfelder & Mandell, 2011; Kasari & Smith, 2013; Van de Ven & Johnson, 2006; Weisz et al., 2012).

Community-based studies may help to mend this gap because the intervention is more

likely to be sustained after the research is completed (Baker-Ericzen, Stahmer, & Burns, 2007; Kasari & Smith, 2013; Mandell et al., 2013). Though the literature suggests that in the absence of clear treatment evidence for children on their caseload, a clinician's instinct to mix treatment approaches to meet the needs of patients may not be detrimental (Kasari & Smith, 2013; Odom, Hume, Boyd, & Stabel, 2012; Weisz et al, 2012), few studies have evaluated these eclectic community intervention approaches. The Interagency Autism Coordinating Committee (IACC) listed the scaling up and implementation of evidence-based interventions in community settings to improve the quality of life for people with ASD as part of their 2016-2017 strategic plan. By using community-based research methods to examine the efficacy a group treatment program for children with ASD in North Carolina, this study aligns with that IACC goal.

The TEACCH GoriLLA Group

The purpose of the Growing, Learning, and Living with Autism (GoriLLA) group at the Chapel Hill TEACCH Autism Center is twofold: (1) to equip children diagnosed with ASD and their parents with self-regulation and social-communication strategies that can be applied throughout their lives, and (2) to increase parent understanding of ASD and their child's unique learning style so that they can advocate for their child's needs. The GoriLLA Group curriculum uses a Structured TEACCHing framework (Klinger, Klinger, & Pohlig, 2006; Mesibov, Shea, & Schopler, 2005; Schopler, Lansing, & Waters, 1983) and includes activities from Social Thinking (Hendrix, Palmer, Tarshis, & Winner, 2013; Winner & Crooke, 2009) and the Zones of Regulation (Kuypers, 2011) in a small group setting. This intervention is parent-assisted, meaning that parents are active participants in the groups, and complete weekly homework activities with their children to increase generalization of skills. Parents who have participated in previous GoriLLA Groups anecdotally report increased use and effectiveness of the intervention strategies at home, and the

demand for the program is high. However, the efficacy of this intervention has yet to be studied in a controlled way. Furthermore, both Social Thinking and the Zones of Regulation are popular and widely used curricula for children with ASD, but neither has an established evidence-base.

The TEACCH Model encourages parents as teachers with the goal of generalizing skills to daily routines across natural environments (Van Bourgondien & Coonrad, 2013); therefore, parents are active participants in the GoriLLA Group intervention. Though early behavioral interventions for children with ASD often employ parent coaching or parent-mediated approaches (see Nevill, Lecavalier, & Stratis, 2016, for meta-analysis), the literature on parent involvement in interventions for older children with ASD is sparse. Frankel and colleagues (2010) tested the Parent-Assisted Children's Friendship Training (CFT) program with children with high functioning ASD using a randomized waitlist control group design. They found significant time by group effects on parent measures of social skills and play date behavior as well as child measures of popularity and loneliness after the 12-week intervention. The same research group (Laugeson, Frankel, Mogil, & Dillon, 2009; Laugeson et al., 2012) used a parent-assisted model called PEERS to teach social skills to adolescents with high functioning ASD, and found improvements on parent report measures. The parent-assisted nature of their PEERS treatment was hypothesized to contribute to the maintenance of treatment gains seen on social measures 1-5 years after the intervention (Mandelberg et al., 2014). In a study of emotion self-regulation in 30-48 month old children with ASD, Laurent and Gorman (2017) found that parents matched their behavior to their child's developmental level and used more behaviors consistent with parents of typically developing two-year-olds; greater use of these parent behaviors (i.e., physical engagement, helping, redirection, and physical comfort) was associated with better child social-communication competence but not child sensory processing competence. Considering these results as well as the

positive treatment effects on emotional co-regulation outcomes found in interventions for young children with ASD (Gulsrud, Jahromi, & Kasari, 2010), it is probable that implementing a parent-assisted intervention model for elementary school-aged children with ASD will improve social-communication and self-regulation treatment outcomes for children and concept knowledge related to these areas for parents.

This community-based research efficacy study aimed to answer the following research questions:

1. Is the TEACCH GoriLLA Group intervention efficacious in teaching self-regulation and social-communication skills to 1st and 2nd graders with ASD and their parents?
 - a. Do 1st and 2nd graders with ASD who participate in the TEACCH GoriLLA Group intervention gain more self-regulation and social-communication concept knowledge during the 12-week intervention period compared to a waitlist control group?
 - b. Do parents of 1st and 2nd graders with ASD who participate in the TEACCH GoriLLA Group intervention gain more self-regulation and social-communication concept knowledge during the 12-week intervention period compared to a waitlist control group?
2. Do gains in concept knowledge by parents or children associated with the TEACCH GoriLLA Group generalize to parent-child interactions after completing the group?
3. Is the GoriLLA Group a socially valid intervention for teaching self-regulation and social-communication strategies to 1st and 2nd graders with ASD and their parents?

The a priori hypotheses for this study were as follows:

(1) Children and parents in the intervention groups would demonstrate an increase in knowledge regarding the social-communication and self-regulation strategies targeted in the GoriLLA Group intervention relative to their respective waitlist control groups.

(2) Self-regulation knowledge would be more likely to increase than social-communication knowledge for this group for two reasons: (a) the group routine and emphasis is more heavily weighted toward these concepts, and (b) social-communication is a core deficit for children with ASD and thus, less likely to change significantly in 12 weeks.

(3) Improved social-communication and self-regulation knowledge would generalize to parent-child interactions for the parents, but not necessarily the children.

(4) Because it was clinically designed to meet the needs of families who use TEACCH services, the GoriLLA Group intervention would receive high social validity ratings from parents.

Method

Participants

Participants in this study were 17 children diagnosed with ASD and their parents. To be included, the children had to have a diagnosis of ASD documented at TEACCH or another clinic, be 80-100% included in a 1st or 2nd grade regular education classroom, reading on grade level, and able to tolerate separation from their parent for up to 30 minutes. In addition, parents and children had to be fluent English speakers. Reading on grade level was a necessary inclusion criterion because concepts and vocabulary were presented at a 1st grade level and worksheets and visuals for the group required 1st grade literacy skills. One child was not 80-100% included at school at the time of study enrollment, but had an Individualized Education Plan (IEP) meeting scheduled to address inclusion at school, which was accepted as filling that study inclusion criterion. In addition, one child had completed an earlier version of the GoriLLA Group intervention over a year prior to the study. Pre-intervention assessment scores indicated that this

child could still benefit from the group and the family met all inclusion criteria, so a decision was made to enroll the family in the study.

Children were 6-8 years old at study enrollment ($M=6.82$ years, $s.d.=.81$) and most of them ($n=14$, 82%) were in the first grade. Four of the children were female (24%), which is consistent with estimates of sex ratios in the larger ASD population (Christensen et al., 2016). The majority of children were White (76%) and non-Hispanic/Latino (88%). Parent education levels were high, with only two parents having completed less than a 4-year college degree and about half of parents holding graduate degrees. This education level is consistent with the population of the Research Triangle region of North Carolina, but much higher than the state as a whole where 28% of the population holds a bachelor's degree (U.S. Census, 2016). All but one child lived in a two-parent household and all but one child was first born. Four families were bilingual, but all parents reported that English was their child's strongest language.

Parents reported that their children were diagnosed with ASD between 18 months and 7 years of age ($M= 3.94$ years, $s.d. = 1.44$). Some of the children were diagnosed with one or more other conditions: Anxiety Disorder ($n = 1$), Attention Deficit Hyperactivity Disorder ($n = 6$), Speech Fluency Disorder ($n = 3$), Fragile X Syndrome ($n = 1$), and Hypothyroidism ($n = 1$). Nine (53%) of the children did not have any reported co-morbid diagnoses. Some parents reported that their children had been treated for diagnoses of Speech Delay ($n = 2$) and Sensory Processing Disorder ($n = 2$) before being diagnosed with ASD. Though all children had a documented diagnosis of ASD, only 5 children in this sample met the ASD cut-off score of ≥ 15 on the Social-Communication Questionnaire (SCQ; Rutter et al, 2003) at the pre-intervention assessment.

After randomization, the study groups were evenly matched on age ($t(16) = .62$, $p \leq .73$) and sex ($\chi^2(1,18) = .06$, $p \leq .80$). The waitlist control group had more non-White families, while

more Hispanic families were randomized to the intervention group, but neither of these differences was significant. Parents of children randomized to the waitlist control group reported significantly fewer symptoms of ASD on the SCQ ($t(15) = -2.08, p \leq .03$) than parents of the children in the intervention group. Parent education levels were not significantly different between the groups.

Table 3.1
Demographic Characteristics of Participants Enrolled in Intervention vs. Waitlist Control Group

	Intervention Group N = 8	Waitlist Control Group N = 9
Child Age at Study Enrollment in Years		
Range	6-8	6-8
Mean (<i>sd</i>)	6.75 (.89)	6.89 (.78)
Child Sex – Girls <i>n</i> (%)	2 (25%)	2 (22%)
Child Race <i>n</i> (%)		
White	7 (88%)	6 (67%)
African-American	1 (12%)	-
Asian	-	2 (22%)
Mixed/Other	-	1 (11%)
Child Ethnicity <i>n</i> (%)		
Non-Hispanic	6 (75%)	9 (100%)
Hispanic	2 (25%)	-
Child's Age at ASD Diagnosis in Years		
Range	2-5	1.5-7
Mean (<i>sd</i>)	4.06 (1.21)	3.83 (1.70)
Child's SCQ* Total Score at Study Enrollment		
Range	9-20	9-18
Mean (<i>sd</i>)	14.5 (4.17)	9.78 (5.07)
Mother's Education <i>n</i> (%)		
Vocational/Assoc. Degree/Some College	-	1 (11%)
College – 4 year degree	6 (75%)	2 (22%)
Graduate/Professional Degree	2 (25%)	6 (66%)
Father's Education <i>n</i> (%)		
Not reported	1 (12.5%)	-
Vocational/Assoc. Degree/Some College	1 (12.5%)	-

College – 4 year degree	2 (25%)	2 (22%)
Graduate/Professional Degree	4 (50%)	7 (78%)

*SCQ=Social-communication Questionnaire

Parents were asked to report interventions that their child was currently receiving and had received prior to starting the study. All but one of the children had an Individualized Education Plan (IEP) at school; the parent of the child without an IEP was in the process of appealing that decision. IEP goals overwhelmingly focused on social-communication skills and pragmatic language. Some children were also receiving occupational therapy for handwriting or additional speech-language therapy for fluency disorders. All of the children had pre-study exposure to “social skills” instruction either in a group or individual setting, most often with a speech-language pathologist but occasionally with an occupational therapist or psychologist. Parents reported that seven of the children had been exposed to the Zones of Regulation curriculum and eight of the children had previous or current exposure to the Social Thinking curriculum; in all but one case, if a child was exposed to one of these curricula, they were also exposed to the other. Twenty-five percent of the intervention group and 60% of the waitlist control group had previous exposure to these curricula. Intervention dosage of Social Thinking and the Zones of Regulation was highly variable as reported by parents. Some parents reported that Social Thinking concepts like “Whole Body Listening” along with non-Social Thinking concepts were used in an intervention, while other parents reported following a weekly curriculum from a specific Social Thinking book. Furthermore, some parents did not provide an IEP or report details of their child’s school intervention, so it is possible that some of the school interventions also used these curricula.

Procedures

A randomized waitlist control group design was used to address the study aims. A recruitment letter was mailed to parents of children on the clinic waitlist for the GoriLLA Group (n

= 31) at the Chapel Hill TEACCH Center. Families from the waitlist were given two weeks to respond to the letter or a follow-up phone call before an email announcing study recruitment was sent to all local patients of the Chapel Hill TEACCH Center in the targeted age range to fill the remaining participant openings. Recruitment letters were also sent to families on the waitlist for services at the Fayetteville TEACCH Center. A total of 36 families responded to these recruitment efforts. The majority of families were recruited from the Chapel Hill TEACCH Center waitlist (n = 12). Seven of the families were recruited from the TEACCH listserv email. The Principal Investigator screened parents by phone to see if they met minimum study inclusion criteria before inviting them for an assessment; 6 families were excluded from the study based on parent responses to these screening questions, conflicts with scheduling, or issues with insurance coverage.

Assessments took place at pre- and post- intervention at the Chapel Hill TEACCH Center. At each 60-90 minute assessment, parent and child intervention strategy knowledge was tested and a 15-minute parent-child play interaction, assessing application of strategies, was completed. Participants were given \$25 for each assessment; thus, they were compensated \$50 for this study if they completed both the pre- and post- assessments. The study Principal Investigator and the TEACCH GoriLLA Group clinicians administered all of the pre-intervention assessments, prior to randomization. Assessors for the post-intervention assessments came from a pool of five master's students in speech-language pathology who were trained to follow study procedures and blind to the family's group allocation. The pre-intervention assessment included observational assessment of some of the study inclusion criteria to confirm that children were a good fit for the groups (e.g., reading grade level text, tolerating their parent out of the room).

The recruitment goal was to have 16 families participate in the study, as four families per group was considered optimal by the TEACCH clinicians; however, to account for possible attrition during the waitlist period, two additional families were over-recruited to the waitlist control group. Eighteen families was the largest sample size deemed feasible for the study, given the constraints of the clinical program. A total of 19 families completed pre-treatment assessments. Eighteen of the 19 families met study inclusion criteria based on the pre-intervention assessment; these 18 families were randomized in blocks of 9 to ensure equal group membership into either the Spring GoriLLA Groups (SGGs) or the waitlist control groups (WLCGs). Two groups of 4 families ran concurrently in the spring while the WLCGs received their services as usual in the community while waiting to participate in the GoriLLA Group in the fall.

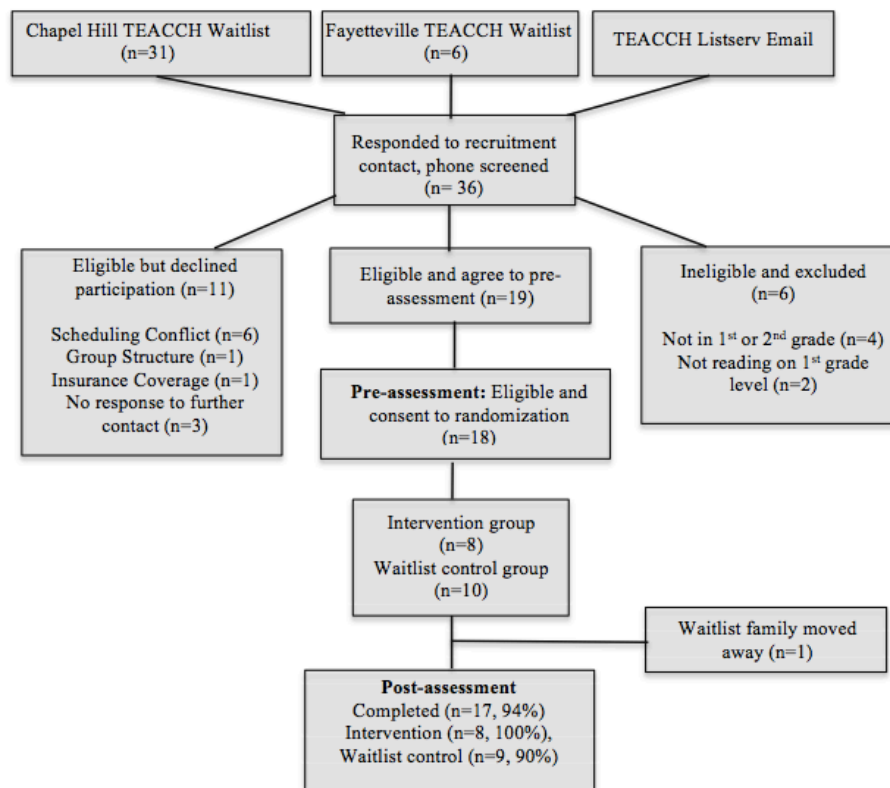


Figure 3.1. Participant recruitment and retention in the GoriLLA group study

Family allocation to each of the two SGGs was not randomly assigned. A two-step process was used to assign these families to a group. First, parents were asked about their schedule and preferred day of the week to receive treatment at the pre-intervention assessment. Conflicts that were so important that they would prevent the family from participating in the study if not accommodated were noted. The second step was to review the children's pre-intervention assessment performance in order to group children who had the most pre-intervention knowledge together and those with the least pre-intervention knowledge together so that session content could be presented and paced appropriately to meet the needs of the group. In all but one case, step 2 aligned with family scheduling needs. The clinical staff at TEACCH reviewed and approved the groupings before parents were notified about scheduling.

Participants were seen for the study using the same HIPAA compliant clinical procedures used at the TEACCH Autism Program. Intervention sessions were billed as psychotherapy groups as part of standard TEACCH practices. GoriLLA Groups met for 90 minutes weekly and sessions consisted of parent-child large and small group activities targeting social-communication and self-regulation. See session titles in Table 3.2 and a sample session agenda in Table 3.3.

Table 3.2

GoriLLA Group Session Sequence

Session	Session Title
Parent Session 1	Introduction to GoriLLA Group and Structured TEACCHing
Parent Session 2	Introduction to Social Thinking and The Zones of Regulation
Parent-Child Session 1	Thinking Thoughts and Feeling Feelings
Parent-Child Session 2	Self-regulation and Me
Parent-Child Session 3	The Group Plan, Part 1
Parent-Child Session 4	The Group Plan, Part 2
Parent-Child Session 5	Thinking with Your Eyes, Part 1
Parent-Child Session 6	Thinking with Your Eyes, Part 2
Parent-Child Session 7	Body in the Group, Part 1
Parent-Child Session 8	Body in the Group, Part 2
Parent-Child Session 9	Whole Body Listening
Parent-Child Session 10	Putting it all Together

Table 3.3

Sample GoriLLA Group Treatment Session #3 “The Group Plan, Part 1”

4-4:30pm Large Group	
<ul style="list-style-type: none"> • Arrival activities: snack and vocabulary/concept review worksheet • Chair Yoga • Zones of Regulation Check-In • Group vocabulary/concept review game – “Feed the Gorilla” • Introduce new concept: “The Group Plan” 	
4:30-5pm Small Group	
Child Small Group	Parent Small Group
<ul style="list-style-type: none"> • “The Group Plan” book and guided lesson plan • Milk pail obstacle course (practice following “the group plan”) • Egg pass game (practice following “the group plan”) 	<ul style="list-style-type: none"> • Homework review • Behavior problem solving • Discuss “The Group Plan” concept and how to use at home • Review purpose of what children are doing in small group • Go over parent role in upcoming parent-child pair activity
5-5:20pm Parent/Child Pairs	
<ul style="list-style-type: none"> • Worksheet applying “the group plan” concept to the home/family environment • Practice self-regulation strategy sequence “Get to Green GoriLLA Plan” in relaxation area 	
5:20-5:30pm Large Group	
<ul style="list-style-type: none"> • Zones of Regulation Check-In • Spotlight Friend (one child shares an activity or experience and the other children practice asking questions) 	

The intervention was delivered by three trained Autism Specialists (clinicians at TEACCH with Master’s degrees in related clinical fields) assisted by a clinical psychology doctoral student or post-doctoral research fellow. Fidelity was monitored via video recordings of each session. Parents completed homework exercises and maintained a log of strategies that they used each week. The core GoriLLA Group strategies and concepts that were tested at pre- and post-assessments and logged each week by parents can be viewed in Table 3.4.

Table 3.4

GoriLLA Group Core Strategies and Concepts

Self-Regulation	
Zones of Regulation	Using concrete terminology and visuals (colors) to make abstract emotion identification and regulation concepts comprehensible to young children.
Stress Balls	Releasing negative feelings and energy by squeezing a ball.
Deep breathing	Visual support for diaphragmatic breathing “smell the flower, blow out the candle”
Progressive relaxation	Step-by-step visual exercise to tense and relax each body part to release tension.
Chair Yoga	Six simple yoga poses with visual instructions.
Drawing/journaling	A method of expressing thoughts/feelings/experiences through writing and drawing.
Visualization	Using positive imagery to shift thoughts from negative to positive. Thought bubbles held above a child’s head are used as visual supports to encourage “thinking a happy thought.”
Social-Communication	
Expected vs. Unexpected Behaviors	Concrete terminology to describe behaviors that give others comfortable/uncomfortable thoughts in various social scenarios.
The Group Plan	Terminology to describe the benefits of working on what the group is doing rather than following “your own plan.”
Thinking with Your Eyes	Method of describing the social information conveyed by social eye gaze shifts, using the visual support of arrows to indicate that “eyes are like arrows,” and how kids can use this information to learn about what others are thinking.
SENSE	Nonverbal conversation skills – Space, Eye Contact, Nodding (gestures), Statements, and Expressions
Body in the Group	Method of teaching the physical boundaries of group participation.
Whole Body Listening	Children learn to identify all of the clues their bodies provide to show they are listening.
Social Narratives	Writing personal narratives from the child’s perspective about behavioral expectations in a particular setting.
Structured TEACCHing	
Pause Cards	Visual reminder to pause an activity and come back to it later.
Visual Countdowns	Physically removing numbers from a countdown to demonstrate when a transition is approaching.
Schedules/Checklists	Use of schedules and activity checklists to inform children about: what’s expected now, when it will be finished, and what’s coming in the future.

All study procedures were reviewed and approved by the Institutional Review Board at the University of North Carolina at Chapel Hill. Informed parental consent was obtained for all participants in the study. If children were over age seven, they assented to their participation in the study.

Instrumentation

Research question 1a outcome measures.

The *Child Observation Protocol* (COP; Carter, Varblow, Brady, & Woods, 2016) is semi-

structured measure of 12 social-communication and self-regulation concepts and vocabulary taught in the GoriLLA Group. The COP was developed by the GoriLLA Group clinicians to assess GoriLLA Group concept and vocabulary knowledge and it was administered at the pre- and post-intervention assessments. Children were seated across from an examiner and asked to follow a visual schedule as they progressed through materials for each task. Items were scored on a 0-3 scale with “3” indicating mastery of the concept; total scores ranged from 0-66. A total score was used as the primary outcome measure for children in the study.

To elucidate the effectiveness of the three major intervention components of the GoriLLA Group, COP items were divided into three theoretically based subscales: Social Thinking, Self-regulation, and Social-communication. The Social Thinking subscale included core concepts and vocabulary from Michelle Garcia Winner’s Social Thinking curricula, primarily the *We Thinkers: Social Explorers* book. Items included in this subscale were: Expected vs. Unexpected Behavior, The Group Plan, Body in the Group, Thinking with Your Eyes, Whole Body Listening, and Labeling Thoughts/Feelings of Others. The Self-Regulation subscale included concepts and vocabulary from the *Zones of Regulation* curriculum (Kuypers, 2011): identifying zones colors, stating body states for each zone, sorting scenarios into reasonable zones, demonstration of calming techniques, and coping with two unexpected events during the assessment (i.e., skipping a scheduled fun activity and waiting to complete a LEGO building task until the end of the assessment). Finally, the Social-Communication subscale included verbal and non-verbal conversation skills taught in the GoriLLA Group, which were coded across the entirety of the assessment interaction with the examiner: sharing information with others, taking turns in conversation, commenting on topics unrelated to own interests, asking questions, using appropriate body language, and recognizing emotion in others.

COP tasks were the same at both assessment time points but some stimuli (e.g., the particular social situations depicted in photographs, the fun activity that needed to be skipped) were changed to minimize memory effects. Assessors were master's students in speech-language pathology who were blind to the child's group allocation and established reliability with the test creators by having over 80% scoring agreement on two sequential assessment observations, either live or via video recording, prior to administering and scoring the protocol independently. Internal consistency of the COP was fair to good (Cronbach's alpha at Time 1 = .76; at Time 2 = .81; Cicchetti and Sparrow, 1990). Inter-rater reliability data were collected via in-room observation and scoring by a second research assistant for seven (41%) of the post-intervention assessments. The intra-class correlation coefficient (ICC) for the total COP score was .97, which is in the "excellent" range according to Cicchetti and Sparrow (1990). ICCs for COP items were mostly in the "good" to "excellent" range with a few exceptions; item B5 (Eye Contact/Gestures/Body Language; ICC = .16) and item K1 (following eye gaze; ICC = .42) seemed to be particularly challenging social interaction skills to code when observing rather than administering the assessment.

The *Sensory Experiences Questionnaire* (SEQ version 2.1; Baranek, 1999b) is a 43-item parent report questionnaire designed to measure young children's responses to sensory stimuli during daily living activities. Parents were asked to rate their child's responses to sensory scenarios on a scale from 1 (almost never) to 5 (almost always). Higher scores indicate greater frequency of sensory responses (i.e., hyporesponsiveness, hyperresponsiveness, sensory-based interests, repetitions, and seeking behaviors [SIRS]). Parents completed this questionnaire at the pre and post assessments and the results were examined for changes in a child's responsiveness to various stimuli after practicing self-regulation strategies in the GoriLLA Group. A parent report measure

was chosen to measure this construct in addition to the COP because it is likely that children in this age range who attend mainstream school settings have learned to regulate many of their sensory behaviors in the context of a 90-minute one-on-one assessment with a novel examiner. We thought that parents may provide broader insight into their child's daily sensory experiences than could be captured in a brief behavioral assessment. Previous studies have found that the SEQ is reliable and consistent for use with children with ASD (Little et al., 2011) and has demonstrated construct validity (Ausderau et al., 2014).

Research question 1b outcome measure. The Parent Report of Group Outcomes (PROGO; Carter & Brady, 2016) consists of 12 multiple-choice questions tapping general ASD knowledge as well as concepts and vocabulary from GoriLLA Group sessions. It includes 3 open-ended hypothetical scenarios and parents are asked to describe the strategies they would use with their child in that scenario. All parents completed this measure at the pre and post assessments. Scenarios and the order of the multiple-choice questions were changed to minimize memory effects from pre- to post- test. Internal consistency was fair for the multiple-choice questions on this measure (Cronbach's alpha at Time 1= .55, Time 2= .66). The open-ended scenario questions were transcribed and coded for the number of times in each scenario the parent reported that they would use a GoriLLA Group strategy or vocabulary word. The total number of strategies/vocabulary words reported in each scenario at each time point was used in analyses.

Research question 2 outcome measure. The 3 Box Task (Brady-Smith et al., 1999; Howard, Martin, Berlin, & Brooks-Gunn, 2012; NICHD, 1999; Vandell, 1979) is a semi-structured parent-child play observation of parent and child social interaction skills (e.g., Parental Sensitivity, Child Engagement of Parent, Mutuality/Connectedness). This task served as a measure of the generalization of strategies practiced in the GoriLLA Group intervention to parent-child interaction outside of the GoriLLA group. Dyads are given 3 numbered containers and asked to play with the

box contents in sequence over the course of 15 minutes. The exact contents of the boxes changed at each assessment, but they always included: (1) a turn-taking game like Jenga, (2) a set of pretend play figures and their accessories, (3) a picture book. ICCs during a parent-child interaction with 36-month-olds from a previous research group (Early Head Start Project) ranged from .54-.69, with 89-98% exact coder agreement (Love, 2005). Ten child and parent behaviors were rated from video on a 1-7 scale by a master's student research assistant who was blind to the family's study group allocation. A bachelor's level research assistant was trained to re-rate 20% of the videos as a reliability check (i.e., one of every 5 recordings was randomly selected to be re-rated using a random number generator). Average rater agreement for the 10 ratings was good (mean Exact Kappa = .81). Parent Intrusiveness (Exact Kappa = .18) and Parent Engagement (Exact Kappa = .36) had very low rater agreement compared to the other scales.

Two self-regulation presses were added to the 3 Box Task for this study in order to directly assess generalization of the self-regulation concepts learned in the group to parent-child interactions: 1) An auditory interruption occurred during the play session when a clock alarmed for 30 seconds; 2) a delayed gratification task wherein the child was given a mini cupcake at the start of the play time and told that they would receive a second cupcake if they delayed eating the first cupcake until the examiner returned. The alarm task was coded for child self-regulatory behaviors (e.g., covering ears, asking parent to turn it off) and attention shifts (e.g., looking at alarm, looking at parent for assistance) during the 30-second period that the alarm is sounding. The delayed gratification task was coded for parent (e.g., distracting the child from the cupcake) and child (e.g., touching the cupcake) behaviors in 30-second intervals across the entire 15-minute play period.

Research question 3 outcome measures.

The *Strategy and Concept Use Log* (SCUL) is a one-page checklist of the self-regulatory

and social-communication strategies and concepts taught in the GoriLLA Group. Parents were asked to circle each of the strategies that they used during the past week, tally the number of times the strategy was used or concept was discussed with their child, and rate the effectiveness of the strategy for the week overall on a scale from 0-3. A “3” rating indicates that the strategy was “always” effective when used that week. This log was completed at pre- and post- assessments.

The *GoriLLA Group Social Validity Measure*, based on the *Social Validity Questionnaire for Parents* (Barrett, 2005), is an 11-item tool designed to tap parent’s satisfaction with the intervention. Items are coded from a 1 (Not at all) to 4 (Always) scale. Parents in the intervention group completed this measure at post-test.

ASD symptom measure. The *Social-Communication Questionnaire* (SCQ; Rutter Bailey, and Lord, 2003) was completed by parents at the pre-intervention assessment to describe the child’s current clinical symptom levels of ASD. As previously reported in the demographics section of this chapter, only 5 of the children in the study met the clinical cut-off for ASD.

Fidelity measure. The *GoriLLA Group Fidelity Tool* was developed to assess fidelity of the GoriLLA Group curriculum implementation. It includes documentation of attendance, an adherence checklist of session activities and materials, and 5-point ratings for overall Quality and Behavior Management skills used by clinicians throughout the session (higher scores indicate better skills). Clinicians were asked to aim for between 80-100% adherence to their session curriculum. They co-developed the adherence checklists with the PI and had access to them during each session. Two master’s student research assistants in speech-language pathology were trained to reliability on the Quality and Behavior Management ratings and monitored fidelity of the intervention from video recordings. They were also trained in the core treatment components of the GoriLLA Group and reviewed the manual and materials lists before coding each session. Inter-

rater reliability for Quality and Behavior Management ratings was established by coding videos of the pilot group sessions until there was greater than 80% agreement on ratings for three consecutive videos. Each activity was rated for Quality and Behavior Management by the raters and an overall mean of all the activity ratings in the session was used in analyses. Of note, reliability was achieved between the raters early in the study, but then had to be re-established when drift in ratings was identified by the PI following a month-long break from rating. Twenty percent of the recordings were randomly selected for fidelity coding using a random number generator, 4 from the Monday group and 4 from the Thursday group.

Results

All analyses were conducted using JMP 13 Pro (2014) for Macintosh. Although multiple statistical tests were performed within the each outcome to address the research questions, in this preliminary efficacy study project with a modest sample size, I judged it more important to avoid overlooking statistical signals of effectiveness of the GoriLLA Group intervention (Type II errors), to avoid false assertions of effectiveness (Type I errors). Therefore, conservative adjustments to the Type I error rates were not employed.

Research Question 1a

Do 1st and 2nd graders with ASD who participate in the TEACCH GoriLLA Group intervention gain more self-regulation and social-communication concept knowledge during the 12-week intervention period compared to a waitlist control group?

Time by group interactions on the Child Observation Protocol (COP) were tested using repeated measures ANOVA. Significant time by group effects were found for the total COP score ($F(1,15) = 6.90, p \leq .02, \eta^2 = .32$) indicating that the intervention group improved their self-

regulation and social-communication knowledge and skills during the intervention period significantly more than the waitlist control group. When analyzed by subscale, a significant time by group interaction was found for the Social Thinking subscale ($F(1,15) = 4.78, p \leq .05, \eta^2 = .24$). Time by group effects were not statistically significant for the Self-Regulation subscale ($F(1,15) = 4.14, p \leq .06, \eta^2 = .22$) or the Social-Communication subscale ($F(1,15) = 4.14, p \leq .06, \eta^2 = .22$), though effect sizes were large and favored the intervention group in each case.

Though all of the children met the pre-study inclusion criteria, there was one child enrolled in the study who had completed an earlier version of the GoriLLA Group over a year prior to the study. This child was randomized to the intervention group. Though the child did demonstrate some areas that would benefit from GoriLLA Group intervention during the pre-test assessment, this child's score was quite high at pre-test compared to the other study participants. Post-hoc analyses were run on the COP with this child omitted to determine if treatment effects were impacted by the omission. The effects for both the total COP score ($F(1,15) = 10.17, p \leq .01, \eta^2 = .42$) and the Social Thinking subscale score ($F(1,15) = 7.62, p \leq .02, \eta^2 = .35$) were improved with this child's scores omitted. Furthermore, the Self-Regulation subscale reached statistical significance with this child omitted ($F(1,15) = 4.97, p \leq .04, \eta^2 = .26$), but interestingly, the Social-Communication subscale effects decreased ($F(1,15) = 2.73, p \leq .12, \eta^2 = .16$).

Since nearly half of the children had been reportedly exposed to Social Thinking and the Zones of Regulation (in 7 of 8 cases, children were exposed to both), COP performance differences between the children with previous exposure to these curricula ($n = 8$) versus those without previous exposure ($n = 9$) were examined. There were no significant differences in pre-intervention COP scores between children with previous Social Thinking and Zones of Regulation exposure and children without that exposure (Total COP Score: $F(2,15) = .06, p \leq .94$; Social

Thinking Subscale: $F(2,15) = .01, p \leq .99$; Self-Regulation Subscale: $F(2,15) = 2.10, p \leq .16$).

The SEQ was analyzed using repeated measures ANOVA. No time by group effects were found for the sensory response patterns (i.e., SIRS, Hyperresponsiveness, Hyporesponsiveness), for Social and Non-social sensory contexts, or for sensory modalities (i.e., Tactile, Auditory, Visual, Gustatory, Vestibular). Time effects were found for the Auditory modality ($F(1,15) = 5.01, p \leq .04$) in that both groups increased in the frequency/intensity of their auditory sensory responses reported by parents from pre-intervention to post-intervention.

Research Question 1b

Do parents of 1st and 2nd graders with ASD who participate in the TEACCH GoriLLA Group intervention gain more self-regulation and social-communication concept knowledge during the 12-week intervention period compared to a waitlist control group?

Repeated measures ANOVA were used to test for time by group interactions on the multiple-choice section of the Parent Report of Group Outcomes (PROGO). A significant time by group effect was found for the total score on the PROGO ($F(1,15) = 7.06, p \leq .02, \eta^2 = .32$). When analyzed separately by subscale, the Self-Regulation subscale of the PROGO demonstrated a significant time by group effect ($F(1,15) = 6.10, p \leq .03, \eta^2 = .29$), but the Social Thinking ($F(1,15) = 1.29, p \leq .27, \eta^2 = .08$) and ASD Knowledge ($F(1,15) = 1.91, p \leq .19, \eta^2 = .11$) subscales did not, though they had medium effect sizes.

Frequency counts of the number of GoriLLA Group strategies and concepts reported in the three applied scenarios from the PROGO were analyzed using repeated measures ANOVA to test for time by group interactions for each scenario. In the first scenario, targeting self-regulation strategies, parents in the intervention group showed a pattern of slightly increased GoriLLA Group strategies reported from time 1 to time 2 (mean at Time 1 = .4, mean at Time 2 = 1.5), but the time

by group interaction was nonsignificant ($F(1,15)=2.75$, $p \leq .12$, $\eta^2=.15$). Similarly, the second scenario, targeting Social Thinking concepts, showed an increase from Time 1 to Time 2 in the intervention group (mean at Time 1 = .1, mean at Time 2 = .6) as compared to the control group (mean at Time 1 = .6, mean at Time 2 = .4), but there was not a significant time by group interaction ($F(1,15) = 3.44$, $p \leq .08$, $\eta^2 = .19$). Finally, the third scenario, targeting Structured TEACCHing strategies, showed significant time effects ($F(1,15) = 6.25$, $p \leq .02$), indicating that both groups improved from pre to post test, but there were no significant time by group effects ($F(1,15) = .90$, $p \leq .28$, $\eta^2 = .08$). However, in the case of all three scenarios, medium to medium-large effect sizes favored the intervention group.

Research Question 2

Are treatment effects of the TEACCH GoriLLA Group generalizable to parent-child interactions after completing the group?

No GoriLLA Group treatment effects were found to generalize to parent-child social interaction behaviors coded on the 3 Box Task. No time by group interaction were found for parent, child, or mutuality/connectedness behaviors coded during this task. One unanticipated exception was that Parent Detachment increased significantly for parents who participated in the GoriLLA Group as compared to the waitlist control group ($F(1,15) = 4.85$, $p \leq .04$, $\eta^2 = .24$). Time and time by group effects are reported in Table 3.5.

Table 3.5

Results of 3 Box Task

Rated Behavior	Intervention Group Mean(sd) Range	Control Group Mean(sd) Range	Time Effect	Time by Group Effect
Pre-test Parent Sensitivity	5.56 (1.24) 3-7	6.36 (.92) 5-7	$F(1,15) = .42$, $p \leq .53$	$F(1,15) = .42$, $p \leq .53$, $\eta^2 = .03$
Post-test Parent Sensitivity	5.78 (1.20)	6 (1)		

	3-7	4-7		
Pre-test Parent Intrusiveness	2.78 (1.48) 1-6	1.82 (1.17) 1-4	F(1,15) = .99, p ≤ .34	F(1,15) = .15, p ≤ .71, η^2 = .01
Post-test Parent Intrusiveness	2.44 (1.33) 1-5	2 (1.55) 1-5		
Pre-test Parent Cognitive Stimulation	5 (1) 3-6	4.91 (1.64) 3-7	F(1,15) = .32, p ≤ .58	F(1,15) = .32, p ≤ .58, η^2 = .02
Post-test Parent Cognitive Stimulation	4.56 (1.01) 3-6	4.64 (1.80) 3-7		
Pre-test Parent Positive Regard	4.67 (.5) 4-5	5.09 (.94) 3-6	F(1,15) = .31, p ≤ .59	F(1,15) = 1.50, p ≤ .24, η^2 = .09
Post-test Parent Positive Regard	4.56 (.73) 3-5	5.27 (1.10) 4-7		
Pre-test Parent Negative Regard	1.56 (.53) 1-2	1.27 (.65) 1-3	F(1,15) = .01, p ≤ .93	F(1,15) = 2.01, p ≤ .18, η^2 = .12
Post-test Parent Negative Regard	1.56 (.53) 1-2	1.36 (.81) 1-3		
Pre-test Parent Detachment	1.33 (.5) 1-2	1.27 (.47) 1-2	F(1,15) = 1.97, p ≤ .18	F(1,15) = 4.85, p ≤ .04, η^2 = .24
Post-test Parent Detachment	1.89 (.60) 1-3	1.18 (.4) 1-2		
Pre-test Child Engagement	5.56 (1.01) 4-7	5.55 (1.37) 3-7	F(1,15) = .32, p ≤ .58	F(1,15) = 2.13, p ≤ .17, η^2 = .12
Post-test Child Engagement	5.22 (.97) 3-6	5.36 (1.63) 3-7		
Pre-test Child Attention to Objects	6.22 (.67) 5-7	6.36 (.67) 5-7	F(1,15) = 4.17, p ≤ .06	F(1,15) = .27, p ≤ .61, η^2 = .02
Post-test Child Attention to Objects	6 (1) 4-7	6.18 (.98) 4-7		
Pre-test Child Negativity	1.67 (.5) 1-2	1.45 (1.04) 1-4	F(1,15) = 1.09, p ≤ .31	F(1,15) = .004, p ≤ .95, η^2 = .00
Post-test Child Negativity	1.89 (.93) 1-4	1.82 (.75) 1-3		
Pre-test Mutuality/Connectedness	5.44 (.73) 4-6	5.72 (1.10) 4-7	F(1,15) = .72, p ≤ .41	F(1,15) = .72, p ≤ .41, η^2 = .05
Post-test Mutuality/Connectedness	5.22 (.67) 4-6	5.45 (1.04) 4-7		

The Auditory Press during the 3 Box Task did not show any time by group interaction effects. There were time effects found for the Child's Attention to the Alarm ($F(1,15) = 34.65$, $p \leq .01$) and Child Self-Comforting behaviors like ear covering ($F(1,15) = 5.43$, $p \leq .03$). These child behaviors decreased in both groups over time. Time and time by group interactions are reported in Table 3.6.

Table 3.6

Auditory Press Results

Child Behavior	Intervention Group Mean(sd) Range	Control Group Mean(sd) Range	Time Effects	Time by Group Effects
Pre-test Attention to Alarm	2.63 (1.19) 1-4	2.44 (1.24) 1-5	F(1,15) = 34.65, p ≤ .01*	F(1,15) = .99, p ≤ .34, η^2 = .06
Post-test Attention to Alarm	.75 (.71) 0-2	1.11 (1.45) 0-4		
Pre-test Attention to Other	1.88 (.83) 1-3	2 (1.41) 0-5	F(1,15) = .001, p ≤ .98	F(1,15) = .15, p ≤ .70, η^2 = .01
Post-test Attention to Other	1.75 (1.04) 1-4	2.11 (1.27) 1-4		
Pre-test Attention to Parent	1.38 (.92) 0-3	.89 (1.27) 0-3	F(1,15) = 2.67, p ≤ .12	F(1,15) = .25, p ≤ .63, η^2 = .02
Post-test Attention to Parent	.75 (1.04) 0-3	.56 (.73) 0-2		
Pre-test Self-Comforting	.38 (.52) 0-1	.33 (.71) 0-2	F(1,15) = 5.43, p ≤ .03*	F(1,15) = .02, p ≤ .89, η^2 = .00
Post-test Self-Comforting	0 (0) 0-0	0 (0) 0-0		
Pre-test Physical Action Toward Alarm	.13 (.35) 0-1	.11 (.33) 0-1	F(1,15) = 2.01, p ≤ .18	F(1,15) = .01, p ≤ .93, η^2 = .00
Post-test Physical Action Toward Alarm	0 (0) 0-0	0 (0) 0-0		

*Significant at the .05 alpha level

Finally, the Delayed Gratification Press during the 3 Box Task interaction did not demonstrate any significant time or time by group effects in the sample. In fact, most children in the sample were “non-eaters,” meaning that they made an immediate decision to wait for the examiner to return in order to receive a second cupcake and did not demonstrate any behaviors counter to that decision during the 15-minute play period with their parent. This restricted the number of parent and child behaviors that occurred during the interactions. In contrast, about a third (n = 5) of the sample were classified as “eaters,” meaning that, upon hearing the instructions, they immediately decided to eat the cupcake and did so within minutes. This behavior also restricted the number of codeable behaviors, as there was no longer a temptation in the room to

elicit behaviors once the child finished eating the cupcake. There were more “eaters” in the waitlist control group (n=4) than the intervention group (n=1) at the pre-intervention assessment so a treatment effect was not possible to detect; however, it was noted that “non-eaters” were consistent with their decision across time points and only one “eater” became a “non-eater” from the pre to the post assessment.

Research Question 3

Is the GoriLLA Group a socially valid intervention for teaching self-regulation and social-communication strategies to 1st and 2nd graders with ASD and their parents?

Data collected during pre- and post- intervention assessments using the Strategy and Concept Use Log (SCUL) were analyzed descriptively based on the three types of data collected: (1) The change from pre to post assessment in the number of families in each study group who reported using each strategy on a weekly basis, (2) The change from pre to post assessment in the number of times each week that families in each study group reportedly used each strategy, and (3) The change in reported effectiveness of the strategies used by families in both study groups at pre vs. post assessment periods. In all cases, the same parent, or combination of parents, who filled out the SCUL at the first assessment, completed it at the second assessment. It was not expected that all of the intervention strategies would be effective for or implemented by all families in the GoriLLA Group, but rather that, over the course of the intervention, families would find a few of these strategies that were effective and implement them regularly, on at least a weekly basis.

Change in number of families who reported using each strategy on a weekly basis: A greater number of families reported weekly use of the following strategies and concepts as compared to the control group following the GoriLLA Group intervention: Zones of Regulation, Schedules, Relaxation Ball, Progressive Relaxation, Yoga, Pause Cards, Group Plan, SENSE

(Space, Eye Contact, Nodding, Statements, Emotions) Conversation Skills, Body in the Group, and Whole Body Listening. Interestingly, the number of families who reported use of Social Narratives decreased in the intervention group relative to the control group, possibly due to learning the evidence based method of implementing this strategy and realizing that they had not been implementing it correctly before the intervention. Alternatively, this strategy may have been taught to a greater extent to control group children in other intervention programs relative to the emphasis on this strategy in the GoriLLA Group. Similarly, the number of families who reported using some of the Social Thinking concepts (e.g., Expected/Unexpected Behaviors) weekly increased in both groups and may reflect treatment contamination due to the prevalence of these concepts across social skills treatments for children with autism.

Change in frequency of times weekly that families in each study group reportedly used each strategy: Relative to the control group, the intervention group demonstrated an increase in the mean frequency with which they used the following strategies and concepts weekly from pre to post test: Zones of Regulation, Relaxation Ball, Deep Breathing, Yoga, The Group Plan, SENSE, and Body in the Group.

Change in reported effectiveness of the strategies used by families in both study groups at pre vs. post assessment periods: Responses to the effectiveness ratings were limited to the families who indicated that they used a given strategy or concept at least once weekly. Some parents did not rate effectiveness, even if they reported that they used the strategy. A handful of parents rated effectiveness for strategies that they did not report use of weekly, presumably because they used the strategies less frequently than weekly. Relative to the control group, overall mean effectiveness ratings improved for: Progressive Relaxation, Yoga, Social Narratives, SENSE Conversation Skills, and Whole Body Listening. Generally, if parents reported that they used a strategy at least

once weekly, they rated it at least a “1” for “sometimes” effective. It was rare for parents to rate a strategy “3” for “always” effective.

Table 3.7

Strategy and Concept Use Log Results

Strategy/ Concept	Intervention Group Pre/Post Number of families using weekly (n=8)	Control Group Pre/Post Number of families using weekly (n=9)	Intervention Pre/Post Mean Weekly Freq of Use	Control Pre/Post Mean Weekly Freq of Use	Int. Pre/Post Mean Effect	Control Pre/Post Mean Effect
Zones of Regulation Schedules	Pre = 2 Post = 6 Pre = 6 Post = 7	Pre = 3 Post = 4 Pre = 6 Post = 5	Pre = 1.38 Post = 2.5 Pre = 3.63 Post = 3.83	Pre = 1.39 Post = 1.5 Pre = 3.56 Post = 2.88	Pre = 2 Post = 1.75 Pre = 1.92 Post = 2.07	Pre = 2.25 Post = 2 Pre = 2.2 Post = 2.43
Relaxation Ball	Pre = 0 Post = 2	Pre = 0 Post = 0	Pre = - Post = .57	Pre = - Post = -	Pre = - Post = 1.83	Pre = - Post = 2
Deep Breathing	Pre = 4 Post = 4	Pre = 6 Post = 6	Pre = 1.31 Post = 2.14	Pre = 3.72 Post = 1.75	-	-
Progressive Relaxation	Pre = 0 Post = 1	Pre = 3 Post = 2	Pre = - Post = .29	Pre = .44 Post = .75	Pre = - Post = 3	Pre = 2 Post = 2
Yoga	Pre = 0 Post = 2	Pre = 5 Post = 3	Pre = - Post = 1.14	Pre = .39 Post = .41	Pre = - Post = 2.5	Pre = 1.67 Post = 1.5
Social Narratives	Pre = 6 Post = 4	Pre = 2 Post = 4	Pre = 2.36 Post = 1.29	Pre = .57 Post = 1.38	Pre = 2.33 Post = 2.75	Pre = 2.2 Post = 2
Drawing/ Journaling	Pre = 3 Post = 2	Pre = 0 Post = 3	Pre = 1.69 Post = 2	Pre = .28 Post = 1.81	Pre = 2.17 Post = 2.5	Pre = 2 Post = 2.67
Imagery	Pre = 0 Post = 0	Pre = 0 Post = 1	Pre = - Post = -	Pre = - Post = .38	Pre = - Post = -	Pre = - Post = 1
Pause Card	Pre = 1 Post = 2	Pre = 1 Post = 1	Pre = .19 Post = .57	Pre = .11 Post = .88	Pre = .5 Post = 1.83	Pre = 2 Post = 1.75
Visual Countdown	Pre = 2 Post = 1	Pre = 2 Post = 2	Pre = 1.13 Post = .71	Pre = 0 Post = 1.5	Pre = 1.5 Post = 1.75	Pre = 2 Post = 2.5
Expected/ Unexpected	Pre = 2 Post = 5	Pre = 3 Post = 6	Pre = 3.19 Post = 3.17	Pre = 2.94 Post = 2.61	Pre = 2.25 Post = 1.67	Pre = 1.83 Post = 2
Group Plan	Pre = 2 Post = 5	Pre = 2 Post = 4	Pre = .81 Post = 1.71	Pre = 1.75 Post = 2.16	Pre = 1.5 Post = 2	Pre = 1 Post = 1.75
SENSE	Pre = 3 Post = 5	Pre = 1 Post = 2	Pre = .56 Post = 3.14	Pre = .11 Post = 1.16	Pre = 1.33 Post = 2	Pre = 1 Post = 1.5
Body in the Group	Pre = 1 Post = 3	Pre = 2 Post = 3	Pre = .25 Post = 1.29	Pre = 1.75 Post = 1.66	Pre = 2 Post = 2.67	Pre = 1 Post = 1.67
Whole Body Listening	Pre = 2 Post = 3	Pre = 2 Post = 2	Pre = 1 Post = 1.29	Pre = .88 Post = 1.16	Pre = 1.75 Post = 2.67	Pre = 1 Post = 1.5

Seven of the eight parents who received the GoriLLA Group intervention completed the social validity measure. Items were rated on a 1-4 scale with “1” indicating “Not useful at all” and “4” indicating “Very useful.” Overall, parents rated the GoriLLA Group as “Mostly Useful” to “Very Useful” for teaching social-communication and self-regulation skills to their child, helping them to support their child’s development in these areas, and advocating for their child in community settings. Parents unanimously felt that it was helpful for them to participate in the group with other parents of children with ASD. They also enjoyed attending the group and felt that their child enjoyed the group experience “most of the time” to “all of the time.” T-tests were used to examine differences in the two GoriLLA Groups, which met on different days of the week with slightly different Autism Specialist teams. Parents in one of the groups felt that self-regulation skills were significantly less useful for children with ASD in general compared to the other group. The parents in this group started the GoriLLA Group with slightly less self-regulation knowledge than the other group, but these differences were not statistically significant (pretest = $t(6) = 1.45$, $p \leq .20$; posttest $t(6) = .87$, $p \leq .42$). Interestingly, their children started and ended the groups with slightly more knowledge and skills on the COP in this area but these were also not significant differences (pretest = $t(6) = -1.20$, $p \leq .28$; posttest = $t(6) = -.52$, $p \leq .62$). It is plausible that because their children had more knowledge and skills in this area, parents did not feel that these skills were important areas of need for children with ASD. Otherwise, there were no significant differences in social validity responses between GoriLLA Groups that met on different days. Parents whose children had participated previously in group interventions with strategies and concepts from Social Thinking and the Zones of Regulation tended to rate the usefulness of the

GoriLLA Group lower than those who were new to the concepts. For example, one parent noted, “This felt more like nice reinforcement of what we already know.”

Table 3.8

Social Validity Measure Questions, Results, and Group Differences

Question	Total Sample Mean (sd) Range	T-tests for group differences by treatment day
How useful do you think self-regulation strategies are for children with autism in general?	2.57 (.53) 2-3	$t(5) = 2.53, p \leq .05^*$
How useful to do you think social-communication strategies are for children with autism in general?	3.14(.69) 2-4	$t(5) = .60, p \leq .58$
How useful do you think Structured TEACCHing strategies are for children with autism in general?	3.43 (1.13) 1-4	$t(5) = 1.20, p \leq .29$
How useful did you find the GoriLLA Group for teaching your child self-regulation skills?	3.14 (1.21) 1-4	$t(5) = 1.96, p \leq .12$
How useful did you find the GoriLLA Group for teaching your child social-communication skills?	3.29 (.95) 2-4	$t(5) = 2.20, p \leq .08$
How useful did you find the GoriLLA Group for enhancing your ability to support the development of your child’s self-regulation skills?	3.43 (.79) 2-4	$t(5) = .66, p \leq .54$
How useful did you find the GoriLLA Group for enhancing your ability to support the development of your child’s social-communication skills?	3.43 (.79) 2-4	$t(5) = .66, p \leq .54$
How useful did you find the GoriLLA Group for enhancing your ability to advocate for your child at school or in the community?	3.14 (.69) 2-4	$t(5) = -.44, p \leq .68$
How useful did your find the GoriLLA Group for enhancing your understanding of autism and your child’s unique learning style?	3.43 (.79) 2-4	$t(5) = .66, p \leq .54$
How useful was it for you to participate in the GoriLLA Group with other parents of children with autism?	4 (0) 4	Null differences
How much did you enjoy the GoriLLA Group?	3.89 (.38) 3-4	$t(5) = .85, p \leq .44$
How much do you think your child enjoyed the GoriLLA Group?	3.57 (.53) 3-4	$t(5) = .38, p \leq .72$

Treatment Fidelity

Twenty percent of the GoriLLA Group sessions (4 from the Monday group and 4 from the Thursday group) were selected using a random number generator to be coded from video to monitor treatment fidelity. Two master's students in speech-language pathology logged attendance, completed an adherence checklist of session activities and materials, and assigned 5-point ratings for clinician overall quality and behavior management.

Attendance. Most families attended between 10 and 11 ($M = 10.75$, $s.d. = 1.49$) of the 12 sessions; the number of absences ranged from none to four. Parents reported the reasons for absences were due to family and situational factors and events (e.g., vacation, illness, school program), not the intervention itself. Some children ($n = 4$) initially experienced difficulty transitioning from their typical afternoon routine to attending GoriLLA Group, which contributed to some tardy arrivals and child dysregulation at the start of the session (i.e., crying, pouting, refusal to participate in welcome activities). There was also construction on the road to the clinic during the study period, which caused some families to occasionally arrive late to sessions or need to leave early for evening commitments like picking up younger children from childcare.

Adherence. Clinicians were asked to aim for 80-100% adherence to their session lesson plan and materials list. With 100% rater agreement, the coded sessions adhered to the lesson plan with 95% accuracy. In addition, there was 100% compliance with the materials lists during the coded sessions. There were no significant differences found in mean adherence ratings between the two intervention groups, suggesting that despite differing clinician teams, adherence to the curriculum was similar for both groups. Since some groups of children had more pre-intervention knowledge of GoriLLA Group vocabulary and concepts than others, "Bonus Activities" were built into the lesson plans for each session, which were noted by the coders but not counted in the

adherence checklist. Bonus Activities gave the clinicians the flexibility to adjust the session pace to the needs of the group while still adhering to the curriculum checklist. As expected, the GoriLLA Group that was made up of children with more pre-intervention knowledge on the COP at the first assessment moved through the session activities faster and used more “Bonus Activities” (an average of 1 per session) than the group with less pre-intervention exposure to GoriLLA Group Knowledge and Concepts on the COP.

Clinician quality. Quality ratings were given on a 5-point scale where “3” indicated a high level of clinician knowledge and implementation of the curriculum. Ratings higher than “3” indicated specific instances of going above and beyond this level of quality during the session. The mean Quality rating across all rated sessions was 3.07 (s.d. = .13). Considering that this mean also reflects a mean Quality rating over all activities within a session, this overall Quality rating suggests a consistently high level of clinician knowledge and implementation of the GoriLLA Group curriculum during the study. Instances of lower ratings, usually due to a student/trainee implementation of an activity, or higher ratings, usually implemented by the clinician who developed that activity, within each session were neutralized in this overall mean Quality rating. Exact rater agreement on mean session Quality ratings was high at 91%. Monday and Thursday groups had nearly identical mean Quality ratings (Monday = 3.06; Thursday = 3.07) indicating consistency of Quality during the study.

Clinician behavior management. Group member Behavior Management by the clinicians was rated on a 5-point scale. For this rating, a “5” indicates that either no undesirable behaviors occurred during the session or that behaviors were managed quickly and without any on-going issue (e.g., needing to try more than one strategy or reminding the child of the strategy multiple times to manage the behavior). A “4” indicates a high level of Behavior Management wherein use

of strategies by the clinician is effective for keeping the session going, but multiple efforts or strategies to manage those behaviors are needed. The overall mean behavior rating across all activities within the coded sessions between the raters was high at 4.76 (s.d. = .11) indicating a high level of Behavior Management on the part of clinicians when it was necessary during the rated sessions. Exact rater agreement on mean session Behavior Management ratings was only 19% since the whole number ratings were averaged over 8-12 activities; however, when the mean rating was rounded to the nearest whole number, agreement was 100% (e.g., one rater may have a mean rating of 3.38 across 12 activities while the other had a mean of 3.21, which did not precisely match, but for interpretation of the rating system, they were both essentially mean ratings of “3”). Mean behavior ratings were the same (4.76) for Monday and Thursday groups indicating consistency of Behavior Management during the study.

Discussion

This study examined the efficacy of an intervention targeting social-communication and self-regulation concept knowledge in 1st and 2nd graders with ASD and their parents. Overall, the results of this study indicate that the GoriLLA Group intervention is effective in teaching social-communication and self-regulation concept knowledge to children with ASD and their parents. Both parents and children demonstrated an increase in social-communication and self-regulation knowledge after participating in the GoriLLA Group as compared to a waitlist control group. Furthermore, in applied written scenario responses, parents’ use of GoriLLA Group strategies and vocabulary increased from pre to post test, though results were not statistically significant.

The effects of the GoriLLA Group intervention did not generalize to parent report of sensory responses in the children or to parent-child interactions during the semi-structured set of

activities that were part of the pre- and post-test assessment protocol. It is possible that the dosage of this 12-week intervention was inadequate to show generalization effects immediately following intervention. Considering that the significant changes seen on the COP and PROGO were primarily in the area of concept knowledge, rather than application of strategies, it is unlikely that application of strategies would generalize beyond the clinic setting after a 12-week intervention. One goal of having parents participate in the intervention was to increase generalization of knowledge and skills by having parents continue to use the concepts and strategies taught in the groups outside of the clinical setting. If parents do implement the strategies at home, it is possible that generalization effects could be a distal outcome of the treatment. A future direction for this study would be to follow the children and collect parent-child interaction data 6-12 months after completion of the GoriLLA Group. A next step for these data may be to code parent and child application of strategies within the video recorded GoriLLA Group sessions, which may have more potential to show child change in strategy application over time than parent-child interaction sessions.

Another future direction for this study would be to separate concept knowledge from application of skills and strategies for the COP. This measure was primarily designed to tap concept knowledge with limited opportunities to demonstrate application of the skills and strategies. Though the intervention was brief, the treatment efficacy results may be strengthened by showing that children not only improved in their concept knowledge but also their application of the skills and strategies from the GoriLLA Group. One way that this could be done is to separate scoring for the knowledge questions on the COP from the application questions so that there are subscale scores for each of these domains.

Results indicate that the GoriLLA Group is a socially valid intervention for teaching social-communication and self-regulation skills to early elementary school-aged children with ASD. Overall, intervention group parents reported that they enjoyed the groups, found the content effective, and appreciated the opportunity to learn alongside other parents of children with ASD. Attendance records showed that unless families had a pre-planned trip or experienced an unexpected event such as an illness, they prioritized the 90-minute GoriLLA Group session in their schedule. Furthermore, fidelity data show that the GoriLLA Group was feasible for clinicians to implement each week at a high level of quality, even with different clinical teams and practicum students working with each group.

There were two instances of unexpected findings in this study. Before reporting these findings, it should be acknowledged that numerous analyses were conducted on this small sample to obtain the results reported, and multiple testing may have resulted in some spurious results. The first unanticipated finding from the coded parent-child interactions on the 3 Box Task was that Parent Detachment increased significantly from pre to post assessments in the dyads that participated in the GoriLLA Group. One interpretation of this finding may be that parents who participated in the GoriLLA Group were more confident about their child's ability to regulate themselves while playing with toys and as a result, demonstrated more detached parenting characteristics at post-test. Intervention group parents were also more comfortable in the TEACCH building from attending weekly GoriLLA Group sessions and may have demonstrated more of their typical detached parenting behaviors (e.g., answering emails on their phone while their child played) than they would have at pre-test or as compared to the control group parents who may have had the social motivation to impress the research team so that their child would receive intervention.

Another instance of unexpected findings were the time effects on child auditory responses seen on both the SEQ and the auditory alarm task during the parent-child interaction. The time effects were in opposite directions: parents reported an increase in the frequency and intensity of child auditory sensory responses on the SEQ while child behavioral responses to the alarm decreased from pre- to post-test. In this case, the parents' report on the SEQ is more plausible because the alarm task effects are likely due to the alarm stimulus change from the pre to the post assessment. At pre-assessment, an electric alarm clock was present in the room with the parent and child and set to go off during the 3 Box Task. To reduce memory effects at the post-assessment, the examiners set off their phone alarms on high volume right outside the assessment room door. One theory is that children oriented to the alarm less and demonstrated fewer self-comforting behaviors at the second assessment because phone alarms/ringers have become ubiquitous auditory stimuli in modern society as compared to electric alarm clocks. Another possibility is that the sound loudness level may have been less at post-assessment compared to pre-assessment due to the phone being set off outside of the room. These potential explanations address the issue of effects in opposite directions; however, it is still unclear why parents of children in both groups reported a significant increase in auditory sensory responses over this 3-month time period. One possibility is that the social expectations for tolerance of auditory stimuli increase around 1st-2nd grade and, therefore, parents became more aware of their child's challenges with these stimuli. Another possibility is that as parents gained more awareness of their child's sensory needs, either as a result of being in the study or through other means, they were more likely to notice their child's responses and report them on the SEQ. This finding may also be an artifact of the small sample size or this particular sample that may not have been detected in a larger study; a replication of this finding is needed before drawing further conclusions.

There were some limitations to this study. In order to complete the study in a community setting, some decisions were made that affected the rigor of the research protocol. First, the sample size, though it was the largest possible given the resources at the Chapel Hill TEACCH Center, was small and underpowered the analyses to detect effect sizes that were less than large. Though the clinical sample was representative of a “real world” community sample at the Chapel Hill TEACCH Center and included some racial and ethnic diversity as well as four females with ASD, the small sample size prevented examination of racial, ethnic, or sex differences in treatment outcome. Moreover, all children in this study were mainstreamed in their school setting and reading on grade level. These were important research inclusion criteria to make sure that all children could understand the manualized treatment content; however, it is possible that minor modifications could be made for lower-functioning children to benefit from the program. Ensuring that this intervention benefits as many individuals with ASD as possible and that modifications are made, when necessary, for various sub-populations within ASD, is an important next research step.

Assessments were also affected by the community setting in which this study took place. Space, time, and clinic policies at the Chapel Hill TEACCH Center all had to be taken into consideration and limited the number of measures that could be included in the protocol (e.g., using the Autism Diagnostic Observation Schedules to confirm community diagnosis could not be accommodated). Although there was plenty of clinical space and time allotted for the usual 4-5 families seen for pre-post GoriLLA Group assessments clinically, tripling the number of assessments for the study put a strain on those resources. In order to get families in for assessments within a three-week window at each time point, the majority of the research assessments took place during evenings and weekends. The after-hours policy at TEACCH is that at least two

clinicians must be present when seeing families; therefore, more research assistant time was required to complete assessments than originally planned.

Furthermore, the GoriLLA Group interventionists created both the parent and child measures based on their years of experience implementing the groups. Alternate measures of social-communication and self-regulation were considered for use in this study, but no standardized measures were available that were likely to detect the changes in the core targets of the GoriLLA Group after a low-dosage, 12-week intervention period. The clinically-developed measures were revised with pilot data to be more objective for research purposes, detect change over time, and establish reliable administration and scoring procedures, but strong psychometric properties were not established prior to use of these measures for research purposes. Though all of the psychometric data possible were collected and reported to aid in interpreting results of these measures, the use of non-validated measures as primary outcome measures weakens the results of this study. Further research is needed with larger samples of children to determine the psychometric properties of the COP and PROGO.

Since the GoriLLA Group is an eclectic treatment model comprised of three widely used curricula (Structured TEACCHing, Social Thinking, and the Zones of Regulation), treatment contamination was another limitation of this study. Over half of the participants had some previous or current exposure to one of these curricula. Despite asking parents about their child's exposure to these curricula, it was difficult to ascertain the extent to which children had been exposed. Based on parent report in this sample, it seems that there is considerable variation both in services that claim to implement each of these curricula and in the extent to which what is taught in these curricula is communicated with parents. Therefore, controlling for previous exposure to these curricula was a challenge. Comparing the pre-test COP scores of children whose parents reported

previous exposure to Social Thinking and the Zones of Regulation to children whose parents did not report previous exposure yielded no significant differences; however, it is certainly possible that other children in the study had previous exposure to the GoriLLA Group concepts and vocabulary at school and in private therapy sessions of which their parents were not aware. In future studies, communicating with school and private interventionists may more accurately elucidate pre-treatment exposure to these curricula.

Several lessons were learned from engaging in this research-community partnership to complete the GoriLLA Group efficacy study. The team found that more time and communication are needed to conduct productive research within a community setting than is typical of most lab-based studies. This research-community partnership began a year prior to data collection and time devoted to the project on both sides of the partnership was given voluntarily and without additional salary or work load reductions. This required substantial buy-in and dedication to the project from both sides, as well as mutual agreement on the goals of the project, which took time to establish. To fully apply the differing, yet important, expertise from the clinical and research team members to the project, consistent communication was key. For instance, it was very important to the clinical team members to have flexibility to individualize sessions as needed and to maintain the Structured TEACCHing aspects of the treatment, while the research team strove to manualize the intervention as much as possible for the purposes of replication. To compromise on issues like this one, the team met in person weekly, had brief discussions and de-briefings at GoriLLA Group sessions twice weekly, and met with TEACCH administrators once monthly. Overall, the team found that the research-community partnership strengthened the study by making the results more clinically applicable while also maintaining a level of research rigor that would have been challenging in this setting without research team support.

CHAPTER 4: CONCLUDING DISCUSSION OF SELF-REGULATION AND SOCIAL-COMMUNICATION IN CHILDREN WITH AUTISM SPECTRUM DISORDER

This dissertation aimed to address a critical problem in the autism spectrum disorder (ASD) literature: Forty-four percent of children with Autism Spectrum Disorder (ASD) have average cognitive ability (Christensen, 2016), yet their outcomes in adulthood are poor in areas such as employment and social inclusion compared to their peers (Dijkhuis, et al., 2016; Howlin, et al., 2013; Mordre et al., 2012). Because social-communication and self-regulation are skill areas in which high functioning individuals with ASD struggle, targeting these skills through early intervention may ameliorate some of the cascading effects of these deficits on adult outcomes. This dissertation reported the results of two empirical studies. The overall objectives of these studies were (1) to offer preliminary recommendations on the timing of early intervention targets to optimize language and social-communication outcomes in preschool, and then, (2) to evaluate the efficacy of an existing community intervention for early elementary school-aged children targeting social-communication and self-regulation.

The first study used a sample of children who were identified as at-risk for ASD at 12 months based on community screening. The relationship between early social-communication (i.e., joint attention) and sensory regulatory components of self-regulation (i.e., hyporesponsiveness and sensory seeking behaviors) skills at 13 and 22 months was explored through cross-lagged panel analysis methods. Next, distal social-communication and language outcomes in preschool were

added to the models. Results of this study revealed that (1) the constructs of sensory regulation and joint attention are significantly concurrently and predictively related in early childhood (2) joint attention at 13 months was the only significant predictor of both sensory regulatory features and joint attention at 22 months, while sensory regulatory features at 22 months were the only significant predictor of preschool receptive language and social-affective symptom severity.

These findings may have implications for early childhood intervention target sequencing for children at-risk for ASD. It may be possible for early intervention teams to streamline their program of care for a family when there are clear intervention targets and areas of expertise needed at different time periods in the child's development. For example, it may be possible to intervene with a family at critical times in only one of the two developmental constructs of interest in the first study (joint attention and sensory-regulation), rather than addressing both developmental domains simultaneously. For continuity of treatment and development of a positive relationship with the child and family, it could be argued that early interventionists working with children at-risk for ASD, regardless of discipline, should receive training in both joint attention and sensory regulation domains such that the clinician could change targets at ideal periods of time. Several early childhood behavioral interventions for young children with or at-risk for ASD include both of these critical intervention domains (e.g., Adapted Responsive Teaching [ART], Baranek et al., 2015; Joint Attention, Symbolic Play, Engagement, and Regulation [JASPER], Kasari et al., 2010); however, these multi-domain interventions that cross traditional disciplinary lines are not yet standard practice for community early intervention providers. This study suggests that training early intervention providers in these multi-domain interventions may be worthwhile for improving child outcomes.

Parent stress in young children with ASD has been found to negatively impact intervention effects, particularly in more time-intensive parent-mediated interventions (Osborne, McHugh, Saunders, and Reed, 2008). It is possible that knowing where to focus their intervention efforts may alleviate some of the time intensity and stress of early childhood intervention for parents. The results of this study only have implications for the potential developmental sequence of these domains (i.e., what should be targeted and approximately when) but not for the level of intervention dosage, time, and intensity. A productive future research direction would be to determine if intervention intensity could be reduced if intervention targets were more clearly defined at certain time periods and then, if this reduction in intensity alleviates parent stress.

It is important to consider that, while results of the first study in this dissertation support the impact of intervening with children at-risk for ASD as early as 13 months of age, the median age of ASD diagnosis in the United States is 50 months of age and only 42.8% of children who go on to receive a diagnosis of ASD by age 8 receive a comprehensive evaluation before their 3rd birthday (Christiansen, 2016). Although the American Academy of Pediatrics recommends screening for ASD at 18 and 24 month well-child check-ups (Johnson & Myers, 2007), pediatricians do not all follow this guideline (Crais et al., 2014). These statistics represent clear barriers to children receiving the early intervention services that they need, at the time when those services may be most beneficial. In a recent review of 21 early intervention studies for children with ASD targeting joint attention, Manwaring and Stevens (2017) found moderate support for improved language outcomes with about half of the studies having significant group effects on expressive language and about a quarter of the studies having significant group effects on receptive language. The mean age range for children in the studies was 18-84 months, meaning that even the youngest children in these studies were already beyond the 13 month period during which they

may most benefit from early intervention targeting joint attention to improve their language and social-communication outcomes. Community and clinician awareness of early signs of ASD and the importance of very early intervention as well as expedited diagnostic evaluation and intervention enrollment procedures for young children will be essential to the results of this first study translating to community practice.

The second study in this dissertation examined the efficacy of an existing community-based parent-assisted group intervention for 1st and 2nd graders with high functioning ASD targeting social-communication and self-regulation. Overall, results indicated that this intervention was effective for teaching social-communication and self-regulation knowledge and skills to children with ASD and their parents. This finding shows promise for eclectic clinical treatment models in the community that mix multiple curricula to meet the needs of patients with ASD and their families. This study also demonstrates that parent-assisted intervention models are still effective for children with ASD into elementary school, and the strategy of incorporating caregivers into treatment and giving them the strategies to carry over treatment into the home should be considered when designing interventions for school-aged children. For children with working parents who receive their intervention at school, this may mean finding innovative ways to improve communication between clinicians, teachers, and parents such as web or phone application-based tools.

The intervention effects found for parent and child knowledge and skills in the GoriLLA Group did not translate to parent-child interactions. It is certainly possible that the relatively low intervention dosage of this intervention over 12 weeks precludes generalizability to parent-child interactions immediately following the intervention. It is also possible that the 3 Box Task coding was not sensitive enough to detect social-communication and self-regulation change in this group

of children. More detailed coding of the child's social-communication skills (e.g., number of conversational exchanges, quality of gesture use, and use of eye contact) while playing with their parent could detect these changes. The Behavioral Observation of Social-Communication Change (BOSCC; Grzadzinski et al., 2016) is specifically designed to detect changes in this domain following intervention. The BOSCC is presently being adapted for children at this language level and may be an option for coding data like these in the future. Children may demonstrate more self-regulation behaviors in the assessment setting if the stimuli are individualized to the child. For instance, the auditory interruption could be a known challenge reported by the parent (e.g., fire alarm) and the delayed gratification stimulus could be a strongly preferred food or activity for that child (e.g., iPad game). From a research perspective this would make standardizing the protocol more difficult, but the tasks may yield more accurate results. Moreover, physiological measures such as heart rate and skin conductance levels may detect changes in self-regulation following the intervention that are not behaviorally visible, but could be impacting the child's ability to engage in the social interaction with their parent. The feasibility of collecting this type of physiological data in a community setting has yet to be tested.

It is important to acknowledge that the GoriLLA Group study focused exclusively on the high functioning end of the autism spectrum. Though drawn from risk scores on a community-distributed screening tool with no cognitive ability exclusion criterion, the Early Development Project-2 sample also largely included children with average to above average cognitive abilities. Future research is needed to replicate these findings in children with mild to severe intellectual disability. These children may demonstrate a different trajectory of social-communication and self-regulation development in early childhood that could impact intervention targeting. They also may benefit from the GoriLLA Group intervention at school-age, but modifications would be necessary

to ensure that children understood the concepts and that the skills taught were appropriate for their stage of development at that time.

This research highlights the importance of social-communication and self-regulation in the early development of children with or at-risk for ASD. Due to the cascading effects of early developmental skills such as joint attention and responses to sensory stimuli on language and social-communication outcomes in preschool, it is critical that intervention targets are selected and timed to optimize child outcomes. Furthermore, this research demonstrated the efficacy of a community-based intervention targeting these skills in early elementary school, indicating that social-communication and self-regulation concept knowledge can be taught directly to children at this age and also that parents are capable of learning the strategies to support their child in these areas. Overall, this research shows promise for the influence of interventions targeting social-communication and self-regulation in young children with ASD, and their potential for ameliorating some of the challenges that individuals with ASD presently face in adulthood.

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